

Applause on the highway for the Mega-MMBS

Hamburg: Steel plates bridge 2.5-meter gap on the elevated highway K20.

Hamburg. In September, there was applause and relief on Germany's longest road bridge, the elevated highway K20 in Hamburg: within 55 hours, 30 Mega-MMBS were installed, each weighing up to 8 t. These foldable steel plates from MAURER can move in longitudinal direction and will bridge a 2.5-meter gap, which will emerge across the highway and the entrance ramps, for the next five years. The applause was directed at the entire assembly team that mastered this unparalleled major construction task in three-shift operation.

The six-lane A7 highway from the 70s is chronically congested and is to be renovated and extended to four lanes in each direction. Building owner is DEGES. A special highway section is the K20 (elevated highway Elbmarsch), a stilted section of the A7 highway in the Hamburg port area south of the Elbe Tunnel. This longest road bridge in Germany is a multi-segment construction with roadway expansion joints in 52 axes. In total, the bridge features 110 pier axes with about 500 piers.

In three axes, so-called mega supports are installed. These mega supports bear the structure in longitudinal direction. They are the fixpoints where the longitudinal forces of the bridge are transferred. The normal bridge piers feature a diameter of approx. 60 cm, the mega supports are over 5 m in diameter. Despite these huge dimensions, the concrete mega supports with a length of 8 to 10 m as well as the crossbeam are damaged by chloride due to the use of thawing salt. Therefore, they have to be completely dismantled and newly built – while traffic is running. That is supposed to last about five years. In the process, the bridge is supported by a steel construction. The challenge is a 2.5 m wide gap across the roadway right above the crossbeam that results from the dismantling work and has to be bridged – with so-called Mega-MMBS.

MMBS – Modular Bridging System

MMBS (MAURER Modular Bridging Systems) are placed across a construction site to make it trafficable. Moreover, the MMBS elements can be quickly unfolded and locked in place to keep the construction site underneath accessible.

A standard MMBS element consists of three steel plates (two ramp elements, one center plate) that are connected by joints. Typically, they are used for a period of several weeks while, for instance, roadway expansion joints are replaced in order to enable longitudinal bridge movements while the bridge is trafficable at daytime or on individual lanes.

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Mega-MMBS elements before transport to Hamburg. Clearly visible: various recesses to accommodate the anchoring.

Photo: MAURER



Lifting into position of a Mega-MMBS with a 100-t crane.

Photo: MAURER

Steel plates with integrated roadway expansion joints

The Mega-MMBS in Hamburg are considerably larger, more stable and more complex than the standard design. Because they are located underneath traffic for five years, they must be anchored in the superstructure in a particularly secure manner but nonetheless must be capable of being opened. For this purpose, shear dowels featuring a length of 200 mm and a diameter of 80 mm are used. Two shear dowels each on the drive-on and drive-off side will keep an MMBS element in position even if the shear force of a truck applying the brakes acts upon it. In addition, the plate sections lying on the road are protected against uplift forces with four connection anchors each.

The bridging system is complicated by the fact that the roadway expansion joints accommodating longitudinal movements of the bridge are located directly adjacent to the mega supports. This is an additional task the MMBS elements must fulfill. For this reason, roadway expansion joints type MAURER XL1 were integrated in the MMBS that accommodate longitudinal movements of up to 100 mm. In the inner part of the MMBS plate, the connection anchors are mounted onto a shear carriage to allow for movement of the bridging part.

All these requirements lead to the fact that the drive-on and drive-off ramps of a Mega-MMBS element have 26 "holes". For fatigue calculation of the system, the finite element calculation was used and it was determined how to design the elements to make them capable of withstanding five years of traffic without damages. A Mega-MMBS element features a length of 8 m, a width of 1.25 – 1.75 m, a thickness of 90 mm and weighs up to 8 t. In total, MAURER produced 168 meters of MMBS elements for the K20 with a total weight of 660 t. This was necessary since two of the mega support axes are located in a particularly wide area of the highway, the Waltershof junction with currently three main traffic lanes plus breakdown lane in each direction as well as two entrance and exit lanes each.

55 hours of full closure for the installation

All preparatory work culminated in the challenge to install the MMBS at the construction site. The first installation activities were successfully completed on September 18 – 20 and October 9 – 11. The third installation phase is scheduled for May 2021.



The work was done in three-shift operation 55 hours around the clock.

Photo: MAURER

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The MMBS elements were installed during a 55-hour full closure for each installation phase. First, the devices and transport vehicles came in, among them three 100-ton cranes to lift the heavy MMBS plates into position. Project manager Holger Redecker, head of the MAURER subsidiary in Lünen, describes the situation: "The convoy alone that entered the highway at night with rotating lights was really impressive."

24 MAURER fitters worked in three-shift operation, hand in hand with the pavement experts from STRABAG. Even though the Mega-MMBS were "simply" placed onto the existing structure, they had to be exactly positioned in a straight bedding. Therefore, the asphalt was skimmed by means of a fine milling machine and covered with a layer of liquid asphalt.

For anchoring of the shear dowels, tapholes were drilled into in the super-structure, the shear dowels were inserted and cast with epoxy resin. The MMBS elements were lifted into position, exactly placed and fastened by the connection anchors. To make driving over smoother, 10-meter asphalt chocks were placed in front of and behind the MMBS bridging resulting in an incline of 1% only.

Finally, police vehicles took test drives: with different speeds and braking directly on the Mega-MMBS. "... and then there was applause from everyone involved, on Sunday evening, on the highway. That was a first for me, too," admits Redecker.

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Fine-tuning. Visible front right: the roadway expansion joint integrated in the Mega-MMBS.

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, 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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