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Rion–Antirion Bridge: Maurer Söhne produces Expansion Joint featuring the world's largest movement capacity.

Failure-engineered design allows seismic safety

Munich. More than five metres of movement both in longitudinal and also transverse direction – that way, Messrs. Maurer Söhne, Munich set a new bench mark concerning expansion joints in bridge construction. The earthquake-proof carriageway expansion joint has been produced for the bridge from Rion to Antirion crossing the Gulf of Corinth in Greece. First two expansion joints meant for one side of the bridge are on its way to construction site since August 21 and are scheduled to be installed there in December this year.

The bridge from Rion to Antirion nearby Patras has a total length of 2,880 metres. It builds up from the two access bridges supported on pier heads as continuous girders and the 2,550 m long core part, a five span cable-stayed bridge. Challenge set to the bridge builders is not only to overcome the Gulf of Corinth itself but also the fact that there run two continental plates in the depth of that sea arm. Tensions resulting from this regularly cause earthquakes: There are seven, each of a value of more than 4.5 on the Richter scale that were registered the past hundred years, the last from 1995 with a value of 6.2 on the Richter scale.

Normal operation and earthquake case

Theoretically, construction of a huge expansion joint for Rion Antirion Bridge that also copes with the design-earthquake movements might have been imaginable. Though Maurer Söhne chose another way: „That expansion joint, which is one of the world's largest ones, will cope with normal op-

Explanation:
Movement gaps or expansion joints ...
... are the flexible connections of bridges to the mainland. Every car driver can recognize them by the characteristic „clack-clack"-noise (unless he is crossing a low-noise joint of Messrs Maurer Söhne, equipped with the patented noise-reduction system ...). The task of expansion joints is to accommodate the relative movement between bridge and abutment, mainly resulting from temperature differences.
Messrs. Maurer Söhne are international market leader for expansion joints. That is why for many experts the expression "Maurer joint" is a general synonym for expansion joints.

eration movements. In case of earthquake it disposes of additional safety reserves", explains Dr. Christian Braun, managing director of Maurer Söhne and responsible for the sector Bridge Accessories. Normal operation on the one hand comprises for customary use the applicable effects from temperature, wind and braking and – on the other hand – the tectonical movements of the Peleponnes moving towards the mainland as well as smaller earthquakes to be expected more frequently.
Due to the length of the bridge, this particular normal case requires an expansion joint with 23 centre beams. They are supported on parallel swivel joists, which, except from the edge joists run slightly inclined to the carriageway direction. The parallel joists safeguard that the longitudinal opening and closing movements of the bridge are equally distributed to the gaps between the centre beams. This is how the expansion joint manages bridge movements of nearly 2,480 mm in longitudinal direction. During normal operation lateral and vertical movements of ± 100 mm (laterally) and ± 63 mm (vertically) respectively are compensated.

Failure-engineered design for earthquake case

The expansion joint is equipped with three failure-engineered areas for the maximum earthquake case to be expected: For the opening movement in longitudinal direction, the closing movement in longitudinal direction and the movement transverse to carriageway. All reserves are such designed that the expansion joint remains at least traversable for the ambulance service and can be repaired within a short period of time. All movable parts of the expansion joint also follow rapid earthquake movements of 1.6 m/sec.

A little quake of grade 1 is not yet relevant to movements in longitudinal direction, it will be recovered by reserves in the movability of the expansion joint.

A serious earthquake producing extreme stretching of the joint, the strip seals between the centre beams will slip out of their clamping connections and the gap size can increase from 80 mm before (i.e. under normal application) and a maximum of 100 mm in case of minor quake to then 200.4 mm. During that "overstretching" there are still three oversized swivel joists which safeguard the stability and passability of the expansion joint. The remaining joists will be torn out of their supports.

In opposite direction there are two failure-engineered areas repelling extreme earthquakes: Two L-shaped longitudinal profiles form a cavity (fuse-box) at the transition from the expansion joint to the bridge. If, in loadcase "earthquake" the gaps of the centre beams are completely closed, two predetermined breaking points will crack up and the L-profiles meet one into the other. Functionality was proven by tests.

Fuse-box and oversized swivel joists together compensate for a movement of max. 5,010 mm in longitudinal direction.

In transverse direction the support of the expansion joint on special "rail" takes care for the necessary mobility in earthquake case, which means: The edge beam is not solidly anchored in one piece as is customary but is realised as a "double edge". In normal operation this double edge beam is fixed by locking bolts and does not move. In earthquake case the failure-engineered bolts break off and the total expansion joint can move by a maximum of ±2,600 mm.

It is not for the first time that Messrs. Maurer Söhne produce these innovative safety devices as mentioned for the Rion-Antirion Bridge. Experience was gained already, as for example from the Vasco da Gama Bridge crossing the Tejo River in Lisbon, from the Airport in Athens as well as from several bridges in Italy, Israel and Turkey.

Sumptuous transport

The Rion-Antirion-Expansion Joints do not only call for highest technical production know how but the transport from Munich to Greece as well is sumptuous. Loading one half of an expansion joint of as much as 56 tons for one direction to a special heavy load truck takes three hours, journey to Greece takes three weeks.

Both the expansion joints will be installed in December. Each spans 27.2 metres of carriageway width and at medium opening condition has a width of 8,54 metres.

Text: 5,390 keystrokes

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MAU_Dehnfuge1.jpg

The expansion joint hovers: On 21st August the expansion joint of 13.9 meters in length, 5.30 m in width and 1.6 metres in height (loading condition) had been steered to the loading place by special crane.

Photo: Maurer Söhne

MAU_Dehnfuge2.jpg

Precision work: The 56 t expansion joint was supported on the special truck on pre-fabricated crossbars. Looking at the joint from underneath the support bars can be detected. These support bars support the centre beams which will have direct contact with the overrolling wheels. The skewed arrangement of the support bars is responsible for the geometrical control of every single centre beam-movement as well as for the equal distribution of the total movement to the single gaps between the centre beams. The seismic protection system is located at the edges of the expansion joint.

Photo: Maurer Söhne

MAU_Dehnfuge3.jpg

The driver's cab of the special heavy load truck at right hand apparently looking very tiny as well as the three workers underline the dimension of the expansion joint, which in case of earthquake can equalize more than 5 metres of movement in longitudinal bridge direction and ± 2.6 metres in lateral direction.

Photo: Maurer Söhne

MAU_Dehnfuge4.jpg

The first heavy load truck shortly before its departure to Greece. On the left side, the support bars rise above the edge beam of the joint, while on the joint surface several beams secure the preset gap opening of the joint.

Photo: Maurer Söhne