Triple system protecting railroad bridge SG26 in Greece

MAURER matches hydraulic dampers, sliding isolation pendulums and shear keys.

Munich, Domokos. **A well-matched combination of large hydraulic dampers (MHDs), sliding isolation pendulums (SIP-S) and shear keys (HKEs) protects the new railroad bridge SG26 in Greece against seismic-induced damages, stabilizes it against braking forces of the trains and allows for thermal movements with least possible resistance. The MSM® sliding material ensures longevity and stable performance for at least 50 years.**

The SG26 has a length of approx. 300 m and rests on two steel concrete pillars. The arch bridge nearby Domokos is part of the new high-speed railroad line Tithorea-Domokos.

The SG26 is part of the new high-speed railroad line Tithorea-Domokos.

Photo: MAURER

The technical challenge was to integrate the entire structural protection in a well-matched system on the two pillars and the abutments. In Greece, seismic protection is required per se, in addition with vibrations and loads from high-speed operation and common weather-induced movements.

Situation on one of the two bridge pillars. Center front and on the right: two hydraulic dampers in transverse direction, behind them on the left one of four sliding isolation pendulums can be seen, behind that at the outside two longitudinal hydraulic dampers.

Photo: MAURER

Well-matched overall system

MAURER as a specialist for structural protection systems has designed bearings and dampers in such a manner that they achieve the required performance reliably and constantly. The system at a glance:

- 16 hydraulic dampers dissipate the seismic energy, i. e. they convert structural movements into heat and contribute to limiting the bridge movements.
- 12 sliding isolation pendulums transmit the vertical loads, re-center the structure and protect it in case of an earthquake.
- 2 shear keys guide the bridge at the abutments in longitudinal direction.

All components have been designed in accordance with the criteria as stated in the EN15129 standard on anti-seismic devices.

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Dampers respond immediately

The special feature of the hydraulic dampers type MHD is that they operate with a very low alpha value of 0.04 (characteristics: F = C * v^alpha, with C = damping constant, F = response force, v = velocity). In this way, they reduce bridge movements very efficiently since the dampers – even at low velocity – respond with high force, lock up, or ensure a large absorption of energy. When it comes to dissipation of seismic energy, it is not just about the rarely occurring severe seismic shocks but rather the dissipation of energy associated with low velocities. Such earthquakes are much more relevant in number and with regard to their impacts.

In addition, the low alpha value induces a reliable and stable response force. This protects the structure also in case the nominal velocity is exceeded – whereas an undefined increase in force caused by higher alpha could damage it.

In the service load case the hydraulic dampers respond to thermal movements with a negligibly low force without imposing load on the structure. To shock-like braking loads due to passing trains, however, the dampers respond with the necessary force to prevent the structure from movements exceeding 5 – 10 mm, which keeps the deck in position to withstand these regular dynamic force impacts in accordance with local and international standards.

Low internal pressure and a redundant sealing system ensure longevity. In total, 16 dampers were installed: on the two pillars two each in transverse direction and four each in longitudinal direction, on the abutments two each in longitudinal direction.

Sliding isolation pendulums fulfilling a quadruple task

The sliding isolation pendulums type SIP-S fulfill four important tasks in seismic isolation:

- They transfer vertical loads.
- They isolate the bridge deck from the pillars and allow for horizontal displacements.
- They support the MHDs in dissipation of seismic energy.
- They re-center the bridge deck to the center position.

Twelve MAURER SIP-S bearings have been installed, two each on the abutments, four each on the pillars. Eight of them are designed for a maximum vertical load of 37,000 kN each and allow for maximum horizontal displacements of ± 316 mm.

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Shear keys at the abutments

To guide the bridge in longitudinal direction, one shear key type HKE is positioned on the abutments to avoid damages due to transverse offset at the tracks. In addition a transverse offset would disturb the travelling comfort. On the pillars, however, transverse movements of the deck are possible as well, which are reduced by the hydraulic dampers.

In all bearings, MAURER has built in its MSM® high-performance sliding material. It ensures long service lifetime and stable performance of the entire structural protection system and thus protects the entire bridge structure for at least 50 years.

MAURER completed its work at the end of 2017. The bridge opening is scheduled for 2018.

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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 world wide, 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 Danube City tower in Vienna, or uplift bearings for the Zenit-Football-Arena in St. Petersburg. As for steel structures, the BMW World in Munich or the Terminal 2 of Munich Airport count among the reputed projects. In terms of spectacular amusement rides, to be mentioned are the world's biggest transportable Ferris Wheel R80 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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