Mexico: Optimum seismic protection for airport terminal

SIP-DR Special Bearings enable isolation from the subsoil and a short construction period of two and a half years.

Santa Lucía, Mexico. **In the near Mexico City a new major airport is about to be built. To protect the huge terminal against earthquakes, it will be isolated from the subsoil by means of special sliding pendulum bearings – the largest isolated building in Latin America. MAURER delivered 473 bearings, and besides the optimum design of the seismic protection system, the delivery time presented a challenge: on October 17, 2019, the groundbreaking ceremony took place, the seismic protection components were delivered in March 2020. The inauguration is scheduled for March 21, 2022.**

Previously the military airport Santa Lucía was situated on the premises 40 km northeast from the center of Mexico City. Part of the existing structures can be reused for the new international airport Felipe Ángeles (AIFA), the construction costs of which amount to approx. 3.5 billion $. The tower featuring a height of 88 m and the terminal 1, however, will be newly built. The trapezoid-shaped main building is attached to the long row of 38 gates. A mirror-imaged second terminal is planned for the second expansion stage, both terminals are to be connected by a shopping mall. Initially, 20 million passengers have been envisaged, in the final expansion up to 80 million. The longer one of the two runways will feature a length of 4.5 km, thus being sufficient even for the largest airliners.

215,000 m² of building surface

The entire region is highly earthquake-prone. Hence, the terminal with its surface of over 215,000 m² had to be protected against seismic damages and will therefore be horizontally isolated from the subsoil. In this way, immediate readiness for operation is ensured even after a major earthquake. In terms of surface, the building is one of the largest isolated buildings worldwide. Due to the importance and the high security classification, three seismic load cases were used to calculate the isolation systems. The maximum credible earthquake (MCE) shows a return period of 2,475 years and a maximum ground acceleration of about 0.613 g.

To meet these requirements, sliding pendulum bearings type SIP-DR were installed. SIP stands for Sliding Isolation Pendulum. D (Double) indicates that the bearing features two concave surfaces instead of one. In this way, D bearings can be built smaller and more lightweight and assembled more quickly.

The future airport Felipe Ángeles (AIFA).
Grafik: FGP Atelier

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R stands for rotation. The rotations within the range of 0.01 rad result from the changing weight distribution of the soft steel superstructure in the course of the building phases. Moreover, the steel construction superstructure is rather elastic and „fond of moving". In the so-called inner puck, the central steel part of the bearing, a calotte is embedded that serves as a joint. Without the joint, the sliding material MSM® (MAURER Sliding Material) would be at risk to be damaged. MSM® consists of a thermoplastic synthetic material.

Isolate, dissipate, recenter, transfer

The SIP Bearings fulfill the following tasks:

- Reduction of the maximum horizontal accelerations by factor 6 to 0.1 g. This is achieved through isolating the building from its foundations. In this way, the building can freely shift horizontally in all directions through the bearings, with a relative movement of up to ± 300 mm.
- They decelerate horizontal movements by friction and limit them.
- They recenter the building after an earthquake to its initial centered position.
- They transfer approx. 151,000 t of vertical loads of the superimposed building.

The SIP-DR Bearings with MSM® (MAURER Sliding Material) were chosen because of their long service life of at least 50 years certified in the European Approval and their extreme performance reserves in the range of 2.5 times the possible vertical overload. In addition, the production of these type of bearings was capable of meeting the strict specifications regarding speedy delivery.

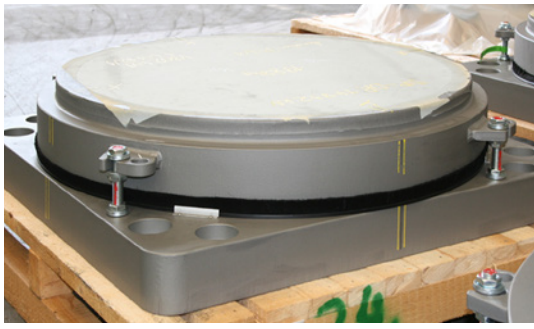
MAURER delivered 473 SIP Bearings for a structural load of 520 t and a horizontal displacement of ± 300 mm. They feature a diameter of 620 mm and a height of 133 mm.

Time is of the essence

In view of the construction period of just under two and a half years, the project is optimized towards quickest possible progress of construction work and is right on schedule after one and a half year. At present, over 1,000 standardized and consecutively numbered concrete bases are standing in rank and file on the former military airport. They were manufactured with large tolerances for bearing positioning to enable quick assembly. Moreover, recesses were prepared for accommodating the anchoring of the bearings. The concrete surface was deliberately left roughened. After embedding the bearing in concrete, this ensures optimum transfer of the shear forces between bearing and concrete.

The entire terminal will be resting on seismic isolators.

Photo: MAURER



Close-up picture of a bearing.

Photo: MAURER

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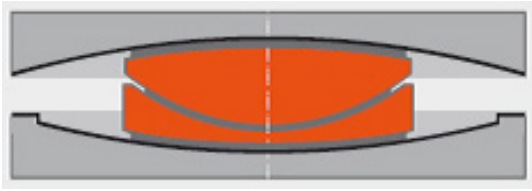
The terminal will rest on a total of 1,332 isolators. Due to quantity and time pressure, the building owner ordered the bearings from two suppliers, one of them being MAURER.

Generals as building owners

A special attribute of the project is the building owner SEDENA (Secretaría de la Defensa Nacional). The project is controlled by generals from the Ministry of Defense. This decision has been made by the President of Mexico, Andrés Manuel López Obrador, to ensure quickest possible construction independent of economic interests. It goes without saying that the requirements of aviation, retail trade and catering trade are taken into consideration; however, the military takes the lead.

MAURER delivered the SIP-DR Bearings by April 2020, all of them were assembled in September. Immediately after completion of the foundation bases with isolators, prefabricated steel constructions will be installed step-by-step.



Cross section of an SIP-DR Bearing.
Graphic: MAURER

Text: 5,867 characters

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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, 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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