High-tech protection in the shadows of the Pyramids of Giza

MAURER isolators dampen the obelisk in front of the world's largest archaeology museum in Cairo.

Cairo. **Egypt is building the largest archaeological museum in the world, with some parts already open to visitors. In front of its entrance stands a stone obelisk named the San Elhagar. It is protected against earthquakes and vibrations by special seismic isolators – MAURER's lead rubber bearings.**

The Grand Egyptian Museum (GEM) in Cairo will be the largest archaeological museum in the world when it fully opens. Covering an area of more than 50 hectares, it is only a few kilometres away from the world-famous Pyramids of Giza. The museum's modern architecture is inspired by ancient Egypt, with monumental staircases, generous lighting and impressive lines of sight to the pyramids characterising the design.

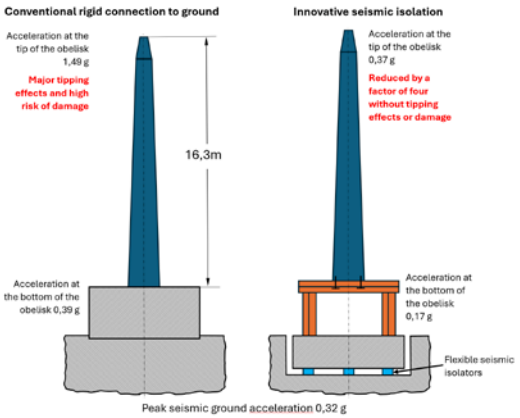
Keeping the exposed obelisk stable

The entrance area is dominated by the 3,500-year-old San Elhagar obelisk. This tall, slim, monolithic stone pillar weighs 87 tonnes and sits on a large baldachin with four pillars. It is believed to have been commissioned by Pharaoh Ramses II, whose seal can be seen as a cartouche on the bottom face of the obelisk's upper section. As the seal can only be seen from below, the four pillars allow visitors to pass beneath the upper section of the obelisk.

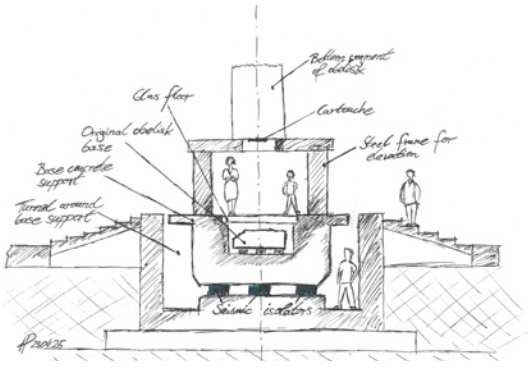
The obelisk was reconstructed after being found broken up into several pieces. Only the bottom piece was not reattached, in order to show the cartouche of Ramses II. This bottom section is now enclosed beneath a glass floor and is also visible to visitors.

The fragile obelisk is glued together and is vulnerable to vibrations of all kinds. In addition, the structure lies in an earthquake zone with a ground acceleration of up to 0.32 g. It therefore needed to be protected by vibration and earthquake isolation. MAURER supplied eight special lead rubber bearings for this purpose.

The Grand Egyptian Museum (GEM) in Cairo.
Photo: MAURER



A comparison between conventional fixed construction and the innovative earthquake and vibration isolation system using lead rubber bearings.
Grafic: MAURER



Schematic diagram and cross-section of the system.
Drawing: MAURER

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MAURER developed these bearings to dampen the dynamic loads exacted on the obelisk. "The main focus here is on reducing accelerations in the event of an earthquake and thus preventing the obelisk from toppling. The damping is also necessary to protect against everyday vibrations caused by traffic and construction machinery. These high-frequency vibrations would eventually cause the obelisk to collapse", explains Raad Hamood, Regional Sales Director Middle East & Africa.

MAURER Lead Rubber Bearings (MLRB)

The seismic isolators used here are MAURER Lead Rubber Bearings (MLRB). These protect against earthquakes and all kinds of high-frequency vibrations.

They have a round design, at the centre of which sits a vertical lead core measuring 45 mm in diameter. This is surrounded by eight natural rubber layers measuring 5 mm in thickness, each vulcanised with 3 mm steel plates. The bearing body has a 10-mm-thick rubber casing and a total diameter of 300 mm. Together with its anchoring plates, each bearing measures just 140 mm in height.

The isolators allow for horizontal movements of ±50 mm during an earthquake. This reduces the earth acceleration at the tip of the obelisk by a factor of four compared to conventional fixed construction. As a result, the obelisk remains stable at earth accelerations of 0.32 g, remaining both upright and undamaged in the event of an earthquake. The rubber layers in the bearings absorb the high-frequency vibrations above 30 Hz caused by traffic and construction machinery, preventing cracks from forming on the obelisk.

The steel-reinforced elastomer body in each isolator transfers vertical loads of up to 898 kN. This isolates the obelisk both horizontally in the event of earthquakes and vertically against high-frequency vibrations. The system also acts like a return spring, always returning to a central position.

- The lead core converts energy into heat through plastic deformation (dissipation). This limits the horizontal movements to max. ±50 mm.
- The bearings meet the EN 1337-3 and EN 15129 standards.

Installation of the lead rubber bearings.
Photo: MAURER

The obelisk at the entrance to the museum is protected against vibrations and earthquakes by lead rubber bearings.
Photo: MAURER

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Seismic isolation technology was the only way to mount the upper section of the obelisk on the steel frame platform and prevent it from toppling in an earthquake. This unique system is also the only way to allow visitors to see the cartouche of Ramses II and experience the obelisk up close. Thanks to the MAURER bearings, this priceless obelisk will therefore stand safely for many more years to come.

Staged opening

The GEM was partially opened in autumn 2024 after almost two decades of construction. In the current test phase, up to 4,000 visitors per day are guided through the 12 completed main galleries. Once complete, the museum will display over 100,000 artefacts. The highlights will include the Solar Boat of the Pharaoh Cheops and the Tutankhamun collection.

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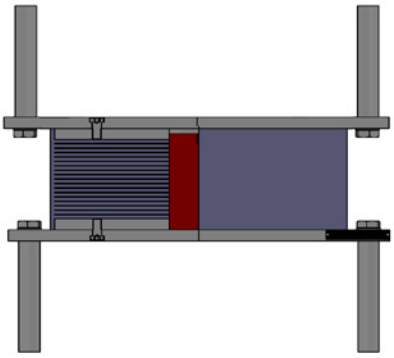
Model of a lead rubber bearing.

Photo: MAURER



Cross-section of a lead rubber bearing: the red part is the vertical lead core, to the left of which are the horizontal natural rubber discs that are vulcanised in layers on steel plates (dark).

Grafic: MAURER

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Quick facts about MAURER SE

MAURER SE is a leading specialist in mechanical engineering and steel construction, with over 1,500 employees worldwide. The company is the market leader in structural protection systems (bridge bearings, expansion joints, seismic protection devices, tuned mass dampers and monitoring systems). It also develops and produces vibration isolation solutions for structures and machines, rollercoasters and Ferris wheels, as well as special structures in steel construction.

MAURER has been involved in many spectacular large-scale projects. These include the world's largest bridge bearings in Wazirabad, Pakistan, earthquake-resistant expansion joints for the world's longest suspension bridge, the 1915Çanakkale in Turkey, tuned mass dampers in the Baku and Socar Towers in Azerbaijan, and the unique guided cross-ties with derailing protection on the Champlain railway bridge in Montreal. Complete structural isolation projects range from the Acropolis Museum in Athens to the new airport in Mexico. MAURER has also worked on spectacular amusement rides, such as the Umadum Ferris wheel in Munich, BOLT™ – the first rollercoaster on a cruise ship, and the world's first duelling rollercoaster at the Mirabilandia Park in Ravenna, Italy.

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