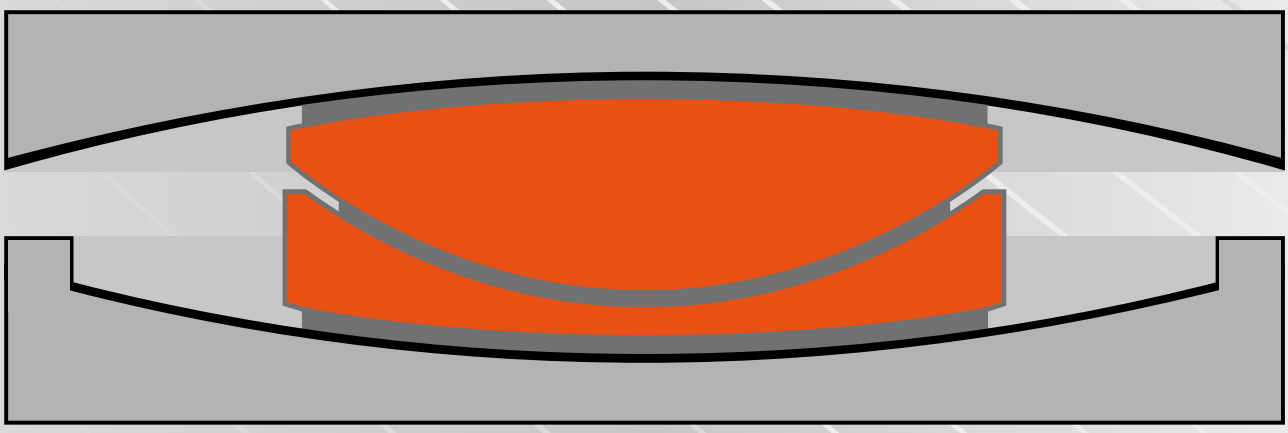
MAURER

MAURER SIP®-Adaptive

Next generation of Sliding Isolation Pendulums



forces in motion

MAURER SIP®-Adaptive

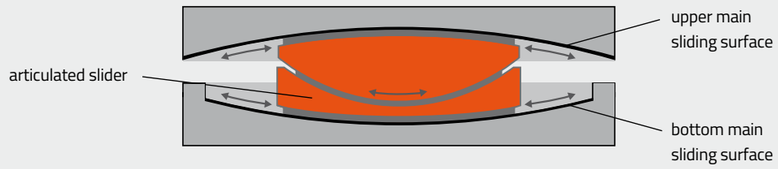
>> MAURER SIP®-Adaptive

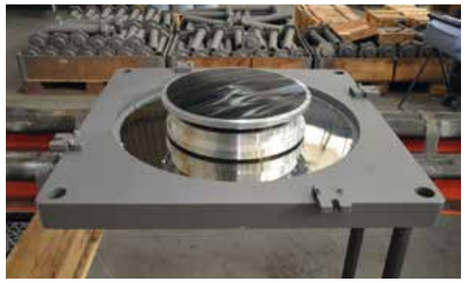
>> INNOVATIVE SEISMIC ISOLATION

Sliding Isolation Pendulums (SIP®) shift the natural period of the structure out of the period range of high seismic energy by their large radius of curvature and further reduce the structural acceleration response by their damping.

The new SIP®-Adaptive represents a further development of the MAURER SIP® series. The adaptive characteristics of the SIP®-Adaptive allow for generating optimum isolation of civil structures independent of intensity (PGA) and frequency of earthquakes.

>> Schematic cross section of SIP®-Adaptive





Bottom main sliding surface with articulated slider

Assembly of SIP®-Adaptive

>> BENEFITS OF SIP®-ADAPTIVE

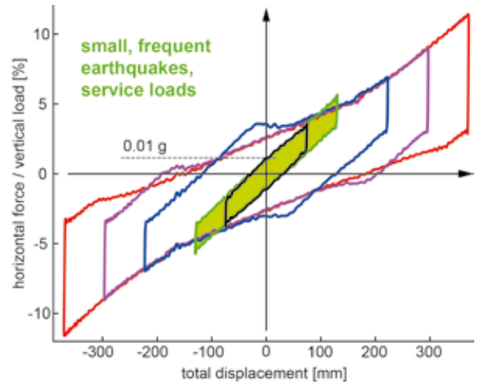
- „3-in-1 system": optimum protection of the structure and its contents against smallest, medium (DBE) and maximum (MCE) earthquakes by strongly reduced minimum base shear down to 0.01 g and significantly reduced peak structural accelerations at all seismic forces.
- Improved structural safety by reduction of maximum base shear respectively maximum peak structural acceleration of up to 50 %.
- Cost-effective due to reduction of displacement up to 30 %
- Rotation capability guaranteed
- Functionality during aftershock ensured
- Extended lifetime (>100 years) due to reduction of wear

>> LEGEND: Curved surface sliders

>> „3-IN-1 SYSTEM" – LOAD-DEPENDENT OPTIMIZATION OF SIP®-ADAPTIVE

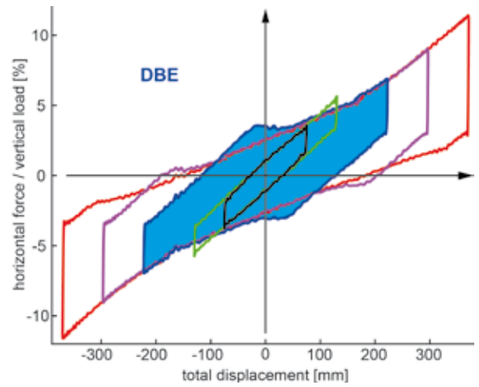
1. Small, frequent earthquakes, service loads (50 y)

- Excellent protection of the structure and its contents due to lowest minimum base shear starting at 0.01 g and smooth transition between static and dynamic friction
- Adjustable minimum base shear



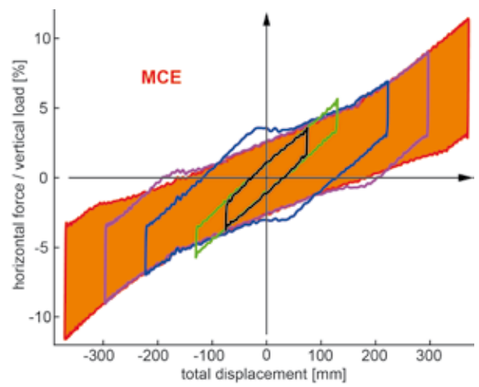
2. Medium seismicity – Design Basis Earthquakes (DBE, 475 y)

- Perfect protection of the structure and its contents by optimized damping and elongated isolation time period
- Lowest base shear levels achievable



3. Maximum seismicity – Maximum Considered Earthquakes (MCE, 2.475 y)

- Increased stiffness and damping; reduced displacement capacity by up to 30 % and maximum base shear respectively peak structural acceleration by up to 50 %
- More effective displacement control by adaptive stiffness and damping

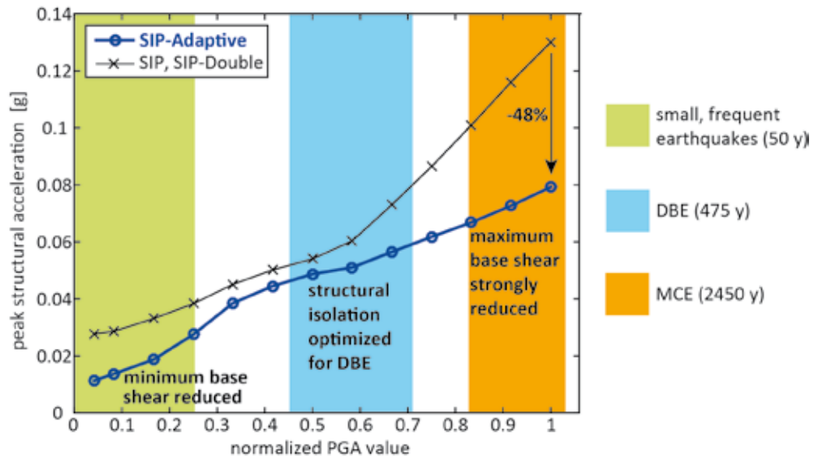


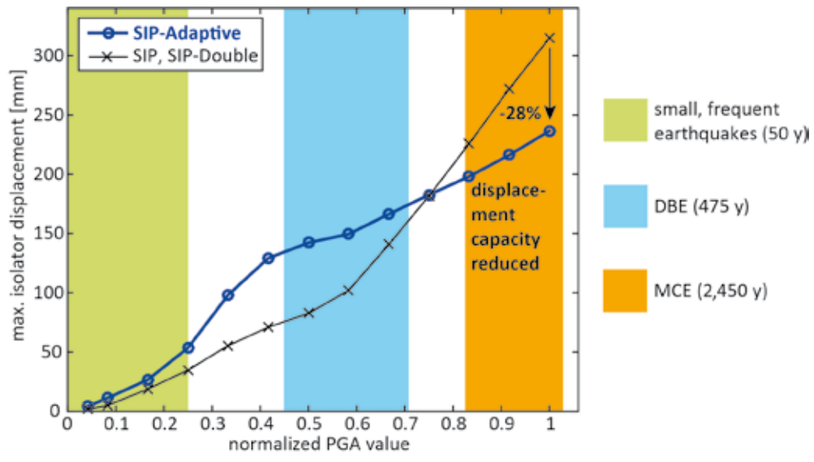
MAURER Sliding Isolation Pendulums

>> OPTIMIZATION BY NON-LINEAR TIME HISTORY ANALYSIS BY MAURER

Required data for the design of the SIP®-Adaptive:

- Earthquake spectrum, detailed structural data
- Necessary base shear for wind load
- Maximum tolerated base shear for DBE
- Maximum structural movement for MCE
- Required service rotation capability





Peak structural acceleration and total bearing displacement as a function of expected seismic intensity (PGA value normalized by PGA of MCE)

>> MAURER Sliding Isolation Pendulums

SIP®-A, Djamaâ El Djazaïr Mosque in Algiers

SIP®, New Akropolis Museum in Athens

		Sliding Isolation Pendulum WITH re-centering			Sliding Isolator WITHOUT re-centering
		SIP®-Adaptive	SIP®-Double	SIP®	SI
					
Seismic performance	small, frequent	+ + + +	+ +	+ +	+ +
	DBE	+ + + +	+ + +	+ + +	+ +
	MCE	+ + + +	+ +	+ +	+
Construction size		+ + +	+ + +	+ +	+ +
Rotation capability		+ + + + ≤ 0.04 rad	+ ≤ 0.003 rad	+ + + + ≤ 0.04 rad	+ + + + ≤ 0.08 rad
Base shear		+ + + +	+ +	+ +	+ + +
Relative displacement		+ + +	+ +	+ +	+
Re-centering capability		+ + + +	+ + + +	+ + + +	+
Total rating		+ + + +	+ + +	+ + +	+ +

MAURER Quality

>> Option MAURER Monitoring System (MMS)

Event-triggered time-continuous measurements	
Structural acceleration	3-axis accelerometer
Ground acceleration	3-axis accelerometer
Isolator displacement	2 orthogonal displacement transducers
Data evaluation during earthquake:	
• Structural acceleration	
• Ground acceleration	
• Isolator displacement	
• Cumulative isolator sliding path	

Testing of SIP®-Adaptive at EUCENTRE in Pavia

>> Quality control

- According to EN 15129 "Anti-Seismic Devices" and other standards (AASHTO)
- CE marking
- Testing by independent universities and notified bodies (San Diego/Pavia/Messina/Munich/Bochum)

>> EXCERPTS FROM CERTIFICATES AND EUROPEAN TECHNICAL APPROVALS FOR:

MAURER MSM® Spherical and Cylindrical Bearings . . . . . .European Technical Approval ETA-06/0131 DIBt
MAURER MSM® Spherical and Cylindrical Bearings . . EC Certificate of Conformity MPA Stuttgart 0672-CPR-0706
MAURER Sliding Pendulum Bearings Type SIP® . . . . EC Certificate of Conformity MPA Stuttgart 0672-CPR-0360
MAURER Sliding Pendulum Bearings Type SIP®-D . . EC Certificate of Conformity MPA Stuttgart 0672-CPR-0632

MAURER References

>> New Acropolis Museum, Athens / Greece

Task:
Structural isolation for protection against earthquakes for a 33.000-ton new building.

Scope of the project:
98 pcs. MAURER MSM® Sliding Pendulum Bearings with upper sliding plate (SIP®) for up to 13.6 MN of superimposed load and ± 255 mm of movement.

>> Djamaâ El Djazaïr Mosque, Algiers / Algeria

Task:
The maximum seismic acceleration on the 145-meter long, 145-meter wide and 65-meter tall main building is around 0.65 g. Even at this acceleration, the structure is protected and does not sustain any significant damage.

Scope of the project:
246 pcs. MAURER MSM® Sliding Pendulum Bearings with two sliding plates and rotation Joint (SIP®-Adaptive) for up to 27 MN of superimposed load and ± 655 mm of movement; MAURER Hydraulic Dampers (MHD) for 2.5 MN of superimposed load and ± 655 mm of movement.

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