SEISMIC PROTECTION OF THREE RECENTLY CONSTRUCTED BUILDINGS BY SEISMIC ISOLATION WITH SLIDING ISOLATION PENDULUM DEVICES

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The SIP is a spherical sliding isolators consisting of three main steel parts with inner sliding surfaces. The shape of the internal part is always spherical with an extra concaved curved surface rather than spherical bearings allowing rotations and horizontal sliding displacements as well. The device is transmitting the vertical loads and is providing free horizontal flexibility, while dissipating energy.

Based on the principles of the spherical bearing 1988 the first pendulum isolator, which was called the Friction Pendulum™ bearing, was invented by Victor Zayas in the United States of America (Zayas and Stanley, 1995). This important, albeit simple modification transforms a structural bearing into a perfect seismic isolator providing the necessary re-centering during and after an earthquake.

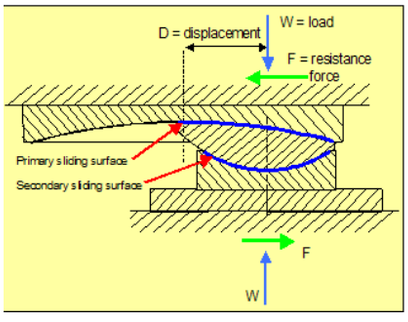

Figure 1. SIP device with primary and secondary sliding surface

The SIP device is the first and only seismic pendulum isolator which is based on the design requirements of EN1337, an European Technical Approval (ETA) and the EN15129 (Medeot, 2006). The device has been fitted with an elasto-plastic polyethylene sliding material (blue in Figure 1) sliding against polished stainless steel in bridge bearing quality with a surface roughness of less than 5µm. This sliding couple for the primary and the secondary sliding surface (Figure 1) provides a well-known and defined amount of dynamic friction, adjustable between µ = 0,005 and µ = 0,08 resulting in a reliable damping ratio ξ_{eff} of the isolator.

$$\xi_{eff} = \frac{2}{\pi} \cdot \frac{\text{area of hysteresis loop}}{\text{area of circumscribed rectangle}} \qquad (1)$$

$$\xi_{eff} = \frac{2}{\pi} \cdot \frac{\mu}{D/R + \mu} = \frac{2}{\pi} \cdot \frac{\mu \cdot R}{(D + \mu \cdot R)} \qquad (2)$$

The horizontal acceleration is reduced by this high structural period especially on the upper floor of the structure. The applied elasto-plastic sliding material (MSM®) provides best possible wear resistance, which was tested full scale at the CALTRANS testing rig of the University of San Diego in California. The Isolator Slider Material MSM®, the tolerance definition of the inner bearing components and detailed inner isolator geometry are according to EN1337, European Technical Approval ETA 06/131 and the EN15129. This material is not subjected to aging which can provide a long lasting system. Also because MSM® is resistant against high temperature and the other parts of SIP are made of Steel, the system totally can resist against fire.

Figure 2. SIP with MSM®

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