Static and Dynamic Friction in Curved Surface Sliders

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Summary

A seismic isolator shall be capable to transmit vertical loads, to decouple the prevailing mass from ground motions, to provide sufficient restoring force, energy dissipation and adequate functionality under service loads and movements. In case of curved surface sliders the friction between the main sliding surfaces is crucial for most of the fundamental requirements listed above. The quasi static coefficient of friction is the significant parameter for the determination of restoring forces due to movements under service conditions. The dynamic coefficient of friction is decisive for energy dissipation and restoring capability during a seismic event. Both these coefficients have to be determined in separate test procedures given in standards EN 1337-2 and EN 15129. This paper gives an overview of the state of the art comparing the European and American design rules.

Keywords: Seismic Isolator, Sliding Material, Sliding Isolation Pendulum, Friction, Friction Pendulum, Recentering Device, Bridge Bearing.

1. Introduction

Anti-seismic devices protect structures during a seismic event. Protection may be given by base isolation, energy dissipation or a combination of both characteristics. Due to the base isolation the structure will be decoupled from the subsoil, i.e. it becomes horizontally free movable to a certain extent. To facilitate this movement capacity while maintaining the safe transmission of vertical loads so called isolators are used. [1] gives an overview of modern isolator types. Laminated elastomeric bearings and sliding bearings are suitable devices for base isolation. Both bearing types shall fulfill the requirements for structural bearings under service condition. In Europe those are specified in the series of standards EN 1337.

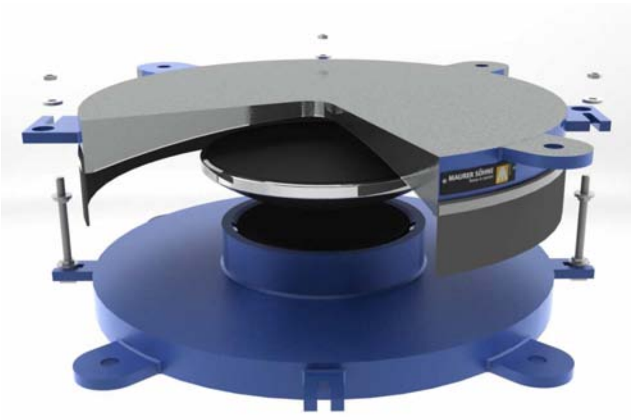

Fig. 1: Curved surface slider

Seismic isolators additionally shall show energy dissipating and, if not given by the structure itself, recentering properties. In the case of elastomeric bearings the restoring force is given by the shear stiffness of the elastomer. The energy dissipation is low, but can be increased using high damping rubber or by insertion of a lead core. A conventional sliding bearing however doesn't show any recentering capability and the lubricated sliding surfaces, which are required to reduce wear and restoring forces, show a negligible energy dissipation. More than 20 years ago the so called friction pendulum bearing, a sliding bearing with a spherically curved main sliding surface, was developed in the US. Due to the accumulation of potential energy an increase of restoring

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