Abstract

This work takes a pioneering approach to a bio-inspired design of seismic isolation systems. There is a growing demand for tunable seismic isolation devices to be widely used in developing countries at affordable cost. This thesis work employs architecture materials concepts and a bio-inspired design approach to formulate, manufacture, and experimentally test a novel seismic isolator. The unit cell of the analyzed device is formed by rigid linkages mimicking the bones of the limbs of the human body, which are connected to a central post through stretchable tendons. The central post carries the vertical load transmitted by the superstructure and can slide against the basis of the system.

This seismic ‘sliding-stretching’ isolator dissipates mechanical energy via friction and the pseudo-elastic recentring force of the tendons. Its displacement capacity can be finely tuned through an optimized design of the geometry of the limb members, while dissipative effects can be adjusted for the application at hand by playing with the geometry, the training cycles, and the material of the tendons.

It can be manufactured in-house using 3D printers and metallic parts provided by local metal framing companies or online suppliers, and hence does not require heavy industry or expensive materials. Its development paves the way to a customizable approach to the protection of artworks, small houses, and essential equipment in industrialized and developing countries.

KEYWORDS: Bio-inspired design, Seismic isolation, 3D printing, Scaling laws