A roller type base isolation device with tensile strength

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Base isolation is an efficient strategy for protecting structures, especially in countries with high seismic risk, such as Chile. This paper presents the conceptual model, mathematical model, experimental validation and numerical analysis of a roller type base isolation device that aims to solve problems of limited tensile strength (compared to its compressive strength) and lateral instability of all types of rubber bearing isolators when faced with elevated axial load. The conceptual model describes the device's components and operation. The mathematical model establishes its constitutive law based on the equilibrium equations formulated considering large lateral displacements. Experimental tests were run on a shake-table with a load frame to simulate the isolator's interaction with the superstructure, considering a combination of the device's design parameters, in order to identify their effect. In the numerical analysis, six simple frame buildings were modelled and subjected to a seismic record using the proposed roller isolator. Error parameters were obtained between the numerical predictions and the experimental results in each loading and unloading cycle, varying between 1.6% and 5.1% for dissipated energy and 4.0% to 17.7% for the magnitude of force. The proposed device worked as a seismic isolator, reducing the structure's response in a magnitude order in relation to the building fixed on its base. © 2020

Experimental validation

Frictional damping

Non-linear mathematical model

Time-history analysis

Compressive strength

Energy dissipation
Nonmetallic bearings
Numerical analysis
Rollers (machine components)
Seismology
Tensile strength
Unloading
Base isolation devices
Efficient strategy
Equilibrium equation
Experimental validations
Lateral displacements
Lateral instability
Loading and unloading
Numerical predictions
Structural design
building
computer simulation
dynamic response
efficiency measurement
numerical model
structural response
tensile strength
Chile