

Video Caption:

Experimental Testing of Double Acting Ring Springs in a Bottom Storey Frame for use in Centralised Rocking Concentrically Braced Frames (CRCBFs), developed at the University in New Zealand.

Abstract

Current earthquake building design philosophy is to prevent collapse of buildings in severe earthquakes and to allow occupants to escape out of the buildings following a severe earthquake even when the buildings are damaged. Recent severe earthquakes in New Zealand have shown that this philosophy works well in practice. However, the extent of damage caused by these earthquakes is considerable, requiring many structural repairs or building demolitions, which causes significant ongoing social and economic disruption. To overcome this, the new philosophy of low damage design is being developed, with the aim for buildings to withstand severe earthquakes without structural repairs, using either or both isolating systems or sacrificial systems that are designed and detailed to not need repair or be readily replaceable without major disruption or loss of operating functionality.

A Centralised Rocking Concentrically Braced Frame (CRCBF) utilising RINGFEDER® Friction Springs allows a building to rock back and forth under severe earthquakes and to return to original position after an earthquake. As the rocking happens at the centre of the system, it halves the magnitude of vertical movement at the CRCBF edges, lessening the vertical displacements of the sides of the frame under lateral loading and hence causing less displacement compatibility issues with the attached floor slabs. RINGFEDER® Friction Springs, are configured as a double acting system and are partially prestressed in cartridges. The partial prestressing ensures that the spring is very stiff under minor earthquakes and wind loading. In a severe earthquake, the spring stacks move both upward and downward as the frame rocks, providing a dependable quantified restoring force that dissipates energy and provide a return force to make the building back to original position without any structural damage. After a design level severe earthquake, the building is expected to be fully operational.

In the experimental testing, the CRCBF, which is represented as single rocking frame, performed very well with a uniform, stable, and repetitive behaviour under severe earthquake records as shown in the video. Therefore, the CRCBF system is a practical solution for a low damage design in buildings.