INTRODUCTION

The innovative Resilient Slip Friction Joint (RSFJ) technology has been introduced to the NZ construction industry in 2016. This damage avoidance technology not only provides life safety but also minimizes the earthquake-induced damage so that the building can be reoccupied quickly. The RSFJ is a friction-based damping device with a special configuration that can produce a flag-shaped hysteresis. This presentation provides some insights on upgrading the current friction-damped bracing systems with RSFJ tension-only braces and information on the latest projects that the technology has been implemented. This includes details on the projects, the way that the technology is implemented, and approach used by the designer to finalize the design.

Seismic upgrading of existing friction-damped braced frames

In this study, an existing braced-frame steel structure (IL2) is upgraded to a high-importance building (IL4) with the response drifts limited to 1.5% and a fully re-centering behavior as an objective. A mix of nonlinear pushover method and non-linear time-history analysis is used for the design.

Hutt Valley Health Hub (HVVH), Wellington, New Zealand

HVVH is an IL4 medical facility located in Wellington, New Zealand. The structure is designed to remain fully functional for a 1/2500 years event. The lateral systems used are timber braces in one direction and rocking concrete shear walls in the other direction. The designer adopted a ductility factor of 2.0 and designed the building based on this assumption. RSFJs were used as bracing elements for the braces and as hold-downs at the base of the rocking walls. The ductility assumption was verified using the capacity spectrum method and Acceleration-Displacement Response Spectra (ADRS) curves.

Catholic Cathedral College, Christchurch, New Zealand

Catholic Cathedral College is an all-timber building where the wall and floor panels are made of Cross Laminated Timber (CLT). This specific type of building is not covered by the current standards, codes or guidelines. For this structure, the concept tested by Hashemi (2016) at the University of Auckland is used where the RSFJ units are used as hold-downs. This configuration creates a ‘controlled rocking’ mechanism in combination with an appropriate shear key. A displacement-based design with hysteretic damping of 13% is used by WSP (Christchurch office) to design the structure.

Fast+Epp Head Office, Vancouver, Canada

This building is a four-storey building located in Vancouver, Canada. Similar to the project above, CLT panels are used as the main structural elements. RSFJs are used as hold-down connectors to introduce ductility to the system to bring down the earthquake demand. By implementing the RSFJ units, the seismic demands can be reduced by a factor of 4. The structure was designed based on the NBCC 2015 standard with ductility factor of Rd=3.0 and Over-strength factor of R0=1.3.

Industrial Building, US

RSFJs are designed for an industrial building in US. The concept used was to use the devices at the bottom chords of a truss system to create a low damage Moment-Resisting Frame (MRF) where inelastic deformations are localized in the dampers. ADRS curves are used to design the building based on FEMA 356. The outcome was comparable to a behavior factor of R=4.0 for this system.