SEISMIC CONSTRUCTION STRONG

New Products, Innovations on Tap

By Larry Kahaner

The earthquakes that hit Nepal in April and May have once again focused the construction industry and world leaders on the devastating loss of life and property involved in seismic events. More than 8,600 people died in the two earthquakes that destroyed more than a half-million homes, leaving many residents exposed to the upcoming monsoon rains.

Many governments are responding to seismic threats. "The market for energy absorption technologies in seismic applications is expanding as global government requirements are changing to protect critical assets, economic loss and loss of life," says Greg Herman, Sr. Project Manager at ITT Enidine Inc. (**www.enidine.com**) in Orchard Park, New York. "Today, new builds and structural retrofits must consider energy absorption devices to mitigate these issues. Seismic protection is no longer an afterthought. Energy absorption technologies are used on an increasing basis to alleviate wind and seismic concerns."

In discussing the company's products, he notes: "Fluid Viscous Dampers (FVD's) are devices that operate by converting kinetic energy into heat, typically over multiple actuations. FVD's are velocity dependent devices; they do not provide damping force or stiffness to a structure unless subjected to external excitation. FVD technologies use the flow of internal fluids and custom orifice geometry to obtain linear and non-linear damping properties. While applying FVD's as energy dissipation devices, a structure will increase its critical damping ratio and reduce the dynamic magnification factor, thereby reducing the dynamic response of the structural system in the event of an earthquake."

Herman adds: "There are different designs and technologies for energy absorption as it relates to seismic damping applications. Selecting the appropriate technology is critical to providing the proper protection of the structure. These selections are based on the application, as there are different requirements for bridge, building (in frame vs. base) and tuned mass damping systems."

He highlights these differences:

- Bridges and base isolation components are often exposed to wind, thermal and traffic excitation on a daily basis. FVD's for these applications must be able to withstand harsh conditions and sustain a long lifespan.
- For buildings, the excitation frequency is significantly less than for bridges. FVD's for these applications should be designed to endure long periods of static installation with features that promote extended life span.
- For tuned mass damping systems, a linear damper is often recommended, as these applications require high energy dissipation in tight spaces and require a relatively high amount of seal travel over the design life.

When it comes to cost, Herman says that FVD's can be a price-effective solution. "In reviewing the total cost of ownership, adding FVD's for energy dissipation can often be a more cost effective solution, especially when coupled with a supplier that represents reduced risk for any associated elements and integration into a project. Because FVD's have the ability to reduce the stress and displacement of a structure, they require less material, reducing the customer's total cost."

At Simpson Strong-Tie (**www.strongtie.com**) based in Pleasanton, California, Marketing Communications Project Manager Elizabeth Rajs is seeing an increasing demand for light-frame, multi-story wood frame buildings. "There are complicated design challenges specifically associated with multi-story buildings that must withstand seismic activity or wind events. Our anchor Tiedown System for Shearwall Overturning Restraint and our Uplift Restraint System for Roofs address those challenges, and have become a popular continuous rod tiedown solution for these types of construction projects. Simpson Strong-Tie has everything engineers need to design the safest building possible with materials specifically suited for the application."

The company has several new offerings, Rajs explains:

- The Simpson Strong-Tie Strong-Rod Systems Design Guide (*F-L-SRS15*) is now available in print or for download at **www.strongtie.com/srs**. This new document guides designers through the specific challenges and solutions available to address multi-story light frame construction shear wall overturning restraint as well as roof wind uplift restraint using Simpson Strong-Tie Strong-Rod Systems. Three methods of specification are explained.
- The Simpson Strong-Tie RTUD5 and RTUD6 ratcheting take-up devices are new additions to their cost-effective line of products for ⅝-inch and ¾-inch diameter threaded rod, respectively. Once installed on top of the BPRTUD5-6 bearing plate, a series of internal threaded wedges enable the device to ratchet down the rod as the wood structure shrinks but engage the rod in the reverse direction when under tensile loading, ensuring continuous engagement is maintained enabling the rod system to perform as designed. Unlike similar products, the RTUD can be attached using nails or screws.
- Simpson Strong-Tie has thoroughly researched and tested practical solutions for concrete podium slab anchorage to provide designers with additional options when designing light-frame structures over concrete podium slabs. The use of the special detailing of anchor reinforcement shown in ACI 318, *Anchorage Provisions*, will allow the full tensile capacities of the anchors to be developed in shallow concrete podium slabs. For assistance, designers can visit **www.strongtie.com/srs** for suggested anchorage-to-podium slab details, slab design requirements and Shallow Podium Slab Anchor Kit product information.
- For other foundation anchorage conditions, design tools, such as the Simpson Strong-Tie Anchor Designer Software, are available to help designers navigate the complex anchorage provisions contained in the ACI 318 reference design standard. Anchor products, including the Pre-Assembled Anchor Bolt (PAB), are also available to simplify specification.

Rajs concludes: "Because no two buildings are alike, each project is optimally designed to the designer's individual specifications.

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Run-assembly elevation drawings and load tables are provided to the designer for approval." (See ad on page 35.)

"Although Taylor Devices (**www.taylordevices.com**)has been designing and manufacturing special dampers and motion control products for approximately 60 years, these types of devices have only been used in structures beginning in the mid 1990s," says Alan Klembczyk, the North Tonawanda, New York company's Vice President, Sales & Engineering."Since that time, we have adapted more and more special spring and damping devices into structures that were previously qualified for classified military and aerospace applications."

Klembczyk says that Taylor Devices has more than 600 structural projects worldwide with these special devices, some of which include a new combination of damping and spring components in either a parallel or series arrangement. "Typical applications include new tall buildings, new medium-sized buildings, retrofits, large bridges, pedestrian bridges and various other structures. The great feature of these Taylor damping products is that due to its output proportional to input velocity, it is the only structural product in use today that functions out-of-phase with the structural response (allowing reduction of stress) and acceleration, along with the reduction of deflection that is provided by all energy dissipation products."

He says that since the company has developed specialized components with non-linear behavior, structural engineers can now engage the added benefits that an optimized product can offer. "Our devices can incorporate linear or non-linear damping exponents, linear or non-linear spring components, pre-loaded mechanisms for zero drift during small inputs, high cycle-life components with no fatigue failures over decades of use, friction-free devices, force limiting devices, shock transmission units and any combination of these attributes. Our 'bag of tricks' in solving structural and dynamic problems has grown for more than six decades," says Klembczyk.

As for topical projects, Klembczyk notes that the company has recently delivered more than 100 non-linear dampers for the new San Diego Central Courthouse Project. These dampers were modeled and analyzed by Skidmore, Owings & Merrill LLP (SOM) as having two distinct Force vs. Velocity regions; one being linear for low velocities experienced during wind events and one being non-linear for the higher velocity range that occurs during seismic events. Wind tunnel testing at RWDI in Guelph, Ontario, provided the site specific wind environment and analysis at SOM verified performance during both these wind and seismic inputs. "With this additional level of analysis performed, our devices enabled an optimized solution for both wind and seismic events," he says.

"Business has been very good," Klembczyk adds. "Our sales and product lines are continuing to grow as more engineers are willing to take a close look at what benefits our products can offer. A relatively simple structural analysis can demonstrate the benefits of adding our devices to their structures. Oftentimes, it is a simple matter of taking that first step for engineers to realize what they may not have considered before."▪