The Legacy of Northridge Lives On

By Larry Kahanar

The January 17, 1994 Northridge, California earthquake dramatically affected how structural engineers conduct the art and practice of building design, probably more so than any other earthquake in recent history. Certainly changes resulted from the 1933 Long Beach earthquake and the 1971 San Fernando earthquake; but it was the Northridge earthquake that led to widespread and sweeping changes in regulation, standards, design and products that have become well-accepted and employed throughout the world.

The growth of performance-based design is probably the most significant change that resulted from Northridge. Although it has been used for decades in the manufacture of cars, airplanes and other mass produced products, performance-based design is difficult to employ in structures because each structure is unique, exists in a different environment, and is built on varying ground conditions.

"Our LA office does a lot of hospital projects, mainly performance-based design, for existing and new buildings," says Aaron Reynolds, Principal of consulting engineers KPFF, Inc., and based in their Los Angeles office (**www.kpff.com**). "The state of the art on seismic design for buildings that need a higher degree of seismic performance is performance-based design, base isolation, or use of modern technology like BRBs." He says: "We are doing a lot of retrofit performance-based design on steel moment frame buildings built in the 70s or concrete shear walls from the 50s."

Adds Reynolds: "There's a number of FEMA and ASCE guidelines for how to model, and we've really gone and tested that to get more performance out of buildings. That's why we're doing complicated, non-linear analyses of buildings. Performance-based retrofitting, with component testing, is the cutting edge in learning about the behavior of buildings and building components… It's the most interesting seismic design we're doing right now."

"We definitely have noticed, in the past few years, an increase in structural engineering firms using performance-based design," says Henry Gallart, President of SidePlate Systems, Inc., based in Laguna Hills, California (**www.sideplate.com**). "Non-linear dynamic analysis is definitely increasing among firms that do this kind of work."

SidePlate offers a suite of high-performance steel frame connection technologies that have successfully been tested to provide protection against blasts, progressive collapse, and earthquakes. The technology was originally developed in response to the devastation caused by the 1994 Northridge earthquake in California, but it has been proven to provide protection for other hazards as well, says Gallart.

Upcoming projects using SidePlate products include the Oakland (CA) Air Traffic Control tower, which begins construction in the fall, and the Scripps Cardiovascular Institute in La Jolla, California.

"Another trend we're seeing," says Gallart, "is that patented construction systems like SidePlate seem to have reached a level of maturity, where more engineers are accepting them and willing to use them…When they've proven to be cost effective, fabricators also have accepted them; and that's also been a factor in engineers' decisions."

Another proprietary system that grew out of the aftermath of Northridge is that of The Spectrus Group's Special Truss Moment Frame (STMF) called *Tru-Frame*, which evolved from an extensive, multi-year study at the University of Michigan.

"We took the study's results and produced a STMF," says John Mayo, President and CEO of The Spectrus Group, Inc. in Auburn, California (**www.thespectrusgroup.com**), a division of JD Squared, Inc. "We added a special segment in the middle of the truss. It yields. We want them to chew up energy, to elongate and not return…After Northridge, lots of buildings had to be closed and redone," he says.

Mayo says that his company has been involved in the construction of about 60 buildings, mainly on the West Coast, including warehouses and military office buildings. "In warehouses, we are able to eliminate chevron bracing, which opens up the interior space… We get rid of the heavy moment connection at the column which requires a lot of welding and inspection. This reduces the weight 25-30 percent and

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