Seismic Projects Picking Up
Offerings Abound

By Larry Kahaner

With the recent earthquake and resulting tsunami in Japan, building owners and engineers are taking a fresh focus on seismic ground mitigation, retrofitting and repair.

Mo Ehsani, President of QuakeWrap Inc. (**www.quakewrap.com**) in Tucson, Arizona, has developed a new Fiber Reinforced Polymer (FRP) called PileMedic (**www.PileMedic.com**) that offers a simple, yet strong and durable, solution for repair of deteriorated piles and columns in buildings, bridges, water and wastewater facilities, industrial plants, and underwater piles. "The fiber is mixed with resin and run through a press," says Ehsani. "This produces a very thin sheet, pre-cured and stiff. It can stand on its own. You can cut a section of this laminate and wrap it around a column without necessarily bonding to, or touching, the column. The space in between can be filled with grout or epoxy. If you apply it with pressure, it will fill cracks and holes. The column doesn't have to be smooth."

So far the company has done about 50 columns on St. Louis bridges and other structures. Ehsani adds: "It's perfect for disaster relief, say, after an earthquake, because it can shore up damaged columns in a few hours."

A company that offers a unique product for seismic protection is Fibrwrap Construction, Inc. (**www.fibrwrapconstruction.com**) of Ontario, California. "We are a specialized contractor that supplies and installs fiber reinforced polymer products, or Fiber Wrap, manufactured by the Fyfe Company," says CEO Heath Carr. "We also perform other structural repair applications, including concrete repair, epoxy crack injection, and specialty coatings."

"When the Fiber Wrap is applied to columns, for instance, for seismic strengthening," says Carr, "it reinforces the structure so that during an earthquake, catastrophic events do not occur, such as building collapse." The company is in the process of completing structural upgrades to three parking structures located in Santa Barbara, California. "The key benefit of the Tyfo Fibrwrap, in this case, is that the city is able to add important structural capacity without changing the look of the downtown buildings which are part of the city's landscape. With the installation of Fiber Wrap, you can add structural value to columns, beams, walls, and even pipelines, with a lightweight, low profile advanced composite material. The foundation is not impacted, even though you're adding significantly to the robustness of the structure; and, at the same time, when the material is applied, the overall profile of the structural member is typically only increased one-quarter to one-half an inch," says Carr. (See ad on page 40.)

Ian Aiken, a Principal with SIE, Inc. (**www.unbondedbrace.com**), in Emeryville, California, says that his company has seen an upswing in the number of buckling restrained brace (BRB) construction projects bidding. "These projects are spread across the entire U.S. and not only concentrated in the western states. We believe that this is

evidence of a slowly improving economy, but with significant growth not expected for another 12-16 months."

He adds: "The Unbonded Brace is the original, and most widely used, buckling-restrained brace in the world, with more than 20 years of research and development behind it." According to Aiken, the Unbonded Brace has been used in nearly 100 projects in the U.S. and more than 700 projects worldwide. Domestic applications include the new 620,000 square-foot, 13-story Kaiser Oakland Hospital, which has recently completed steel erection. He said it is the largest Seismic Zone 4 BRB project in the U.S., using more than 600 Unbonded Braces.

"Unbonded Braces are being used by structural engineers in an ever-increasing number of applications," Aiken says. "Since the engineer knows very accurately at what load the brace will yield and what the brace maximum load is, they are able to efficiently size the other structural members, from the brace connections themselves down to the foundations. It has been shown through numerous studies that significant cost-savings are possible with BRBs over other lateral load-resisting systems."

Even though BRBs are now well-established, it is often the case that the check/review parties are unfamiliar with the details of the technology. Therefore, being able to provide support to the structural engineer, to ensure the fullest understanding by all parties, can be a significant contribution to smooth project outcome."

Also touting the benefits of BRBs is Mike Linford, Project Development, for West Jordan, Utah-based Corebrace, LLC (**www.corebrace.com**). The company began research and development of their BRBs in February of 2001. In November of 2004, Corebrace tested their largest BRBs ever (1100 kips) at the University of California, San Diego. This testing was done to obtain California's Office of Statewide Health Planning (OSHPD) approval to supply Corebrace BRBs for hospital projects. Again, this testing was exceedingly successful, and Corebrace has now been approved for hospital projects, according to company officials. "We make the best BRB Frames on the market. It's a very economical solution for most steel structures, particularly if you're over 3 or 4 stories high," says Linford.

He says that the company fabricates its own braces in the United States and offers four different connection types. "The bottom line is that BRBs can usually save the owner money," says Linford. (See ad on page 38.)

Konrad Eriksen, President of Dynamic Isolation Systems, Inc. (**www.dis-inc.com**), says: "Our main business is base isolation, and we have recently expanded our product line with Viscous Wall Dampers that benefit taller buildings and Low Mass Isolation products that protect equipment and light structures. We have completed over 350 projects in 15 countries."

He notes that McCarran, Nevada-based DIS's main market is Japan, and the predominant structures are new hospitals. "We have also isolated condominiums,

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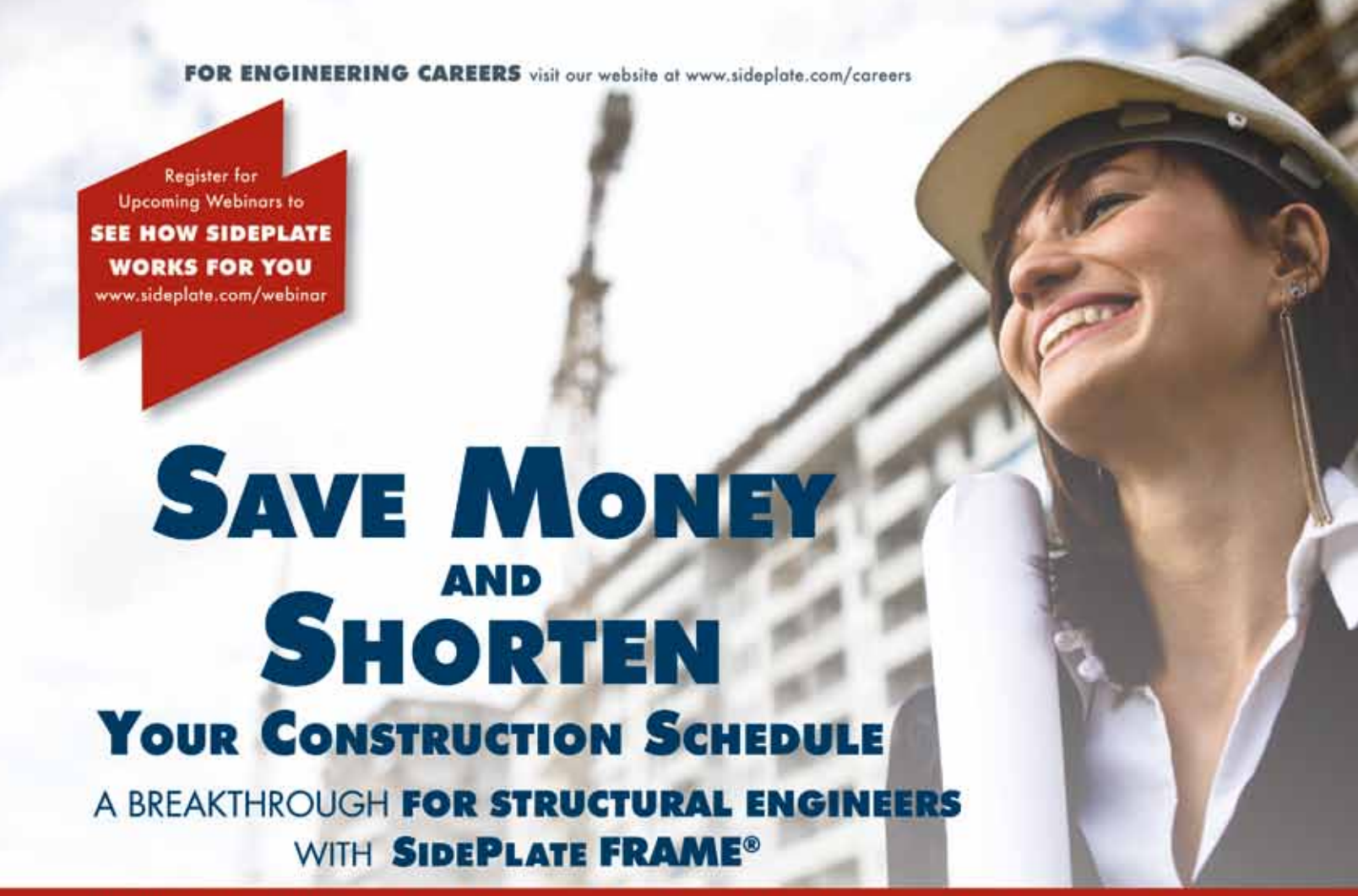

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office buildings, and communications and manufacturing facilities there. Our Viscous Wall Dampers were developed and first used in Japan by our partner there. In New Zealand, we have recently isolated a hospital, a power station, and a boiler at a pulp mill. In the U.S., we have a mixture of hospitals, bridges, and infrastructure, such as wharves. We are also seeing strong interest in the nuclear market."

The company's Viscous Wall Damper (VWD) is being used in a new hospital in San Francisco, located about seven miles from the San Andreas Fault. "The geometry of the VWD allows for more architectural freedom, as it can be placed inside walls and does not intrude into the occupied space as diagonal braces and hydraulic dampers do. The 15 percent system damping reduced the design forces by 25 percent. From a maintenance viewpoint, it has no seals and does not operate under pressure, ensuring reliability throughout the life of the structure," says Eriksen.

Born from the aftermath of California's Northridge earthquake in 1994, Sideplate (**www.sideplate.com**) offers a suite of high-performance steel frame connection technologies that have successfully been tested to provide protection against blasts, progressive collapse, and earthquakes, according to company officials. "Performance is key, but engineers must live in the real world, and any solution must be economical," says Jesse Karns, Vice President of Research and Development at the Laguna Hills, California company. "Sideplate has an advantage in that its performance also makes it economical. By forcing hinge to occur out in the beam, we get a stronger system that is able to resist drifts better and, in doing so, we are able to come up with frame sizes that are smaller and still maintain drift control in earthquakes." Karns adds: "As engineers look more and more at performance-based design, our products look better because performance is something that Sideplate excels at." (See ad on page 37.)

Engineers also are looking to ground improvement for increased seismic protection, especially in geographic areas that were not always considered seismically active. "The biggest change in areas of seismic risk doesn't seem to be in California anymore, where design teams have been addressing it for many years," says Brendan FitzPatrick, Director of North America for Geopier Foundation Company, in Mooresville, North Carolina

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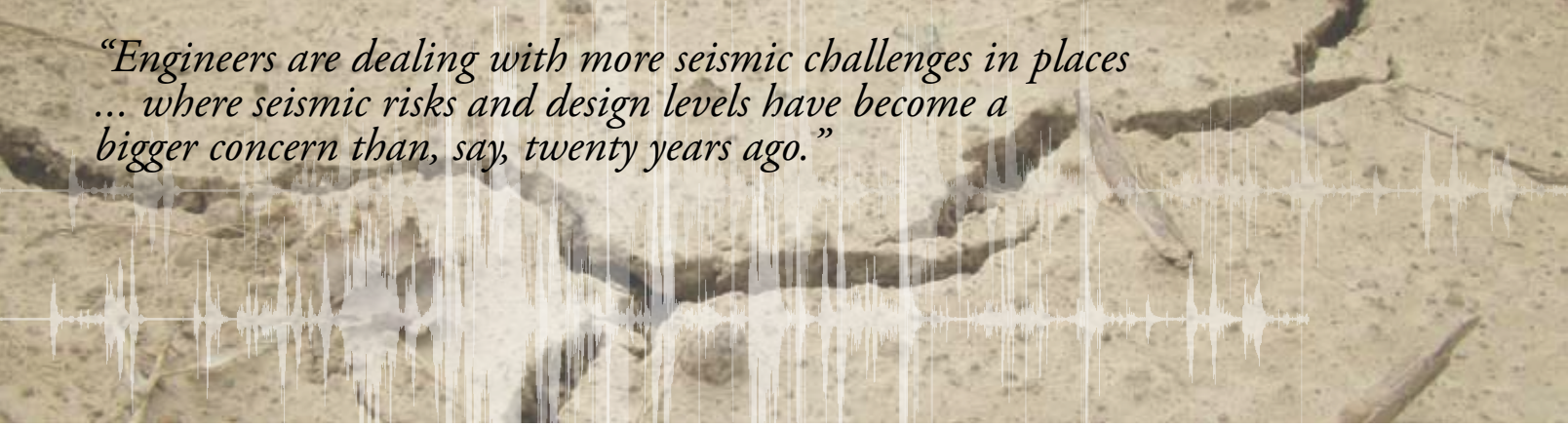

"Engineers are dealing with more seismic challenges in places ... where seismic risks and design levels have become a bigger concern than, say, twenty years ago."

(**www.geopier.com**). "Engineers are dealing with more seismic challenges in places like Tennessee, Illinois, and Kentucky, where seismic risks and design levels have become a bigger concern than, say, twenty years ago."

FitzPatrick notes: "Because of changes in building codes over the last ten years or so, we're seeing a need for increased bearing pressures and higher uplift loads on structures, as well as greater liquefaction risks. We've provided solutions for increased bearing pressures and uplift load resistance, as well as liquefaction, for years using our replacement (Geopier) system. We're now doing more with our displacement (Impact) system to provide the same benefits and reduce the risk of liquefaction to greater depths."

Also working in the ground improvement area is St. Louis-based Subsurface Constructors (**www.subsurfaceconstructors.com**). The company has been engaged in a long-term seismic retrofit project on a bridge in downtown St. Louis. "We have hundreds of micropiles and drill shafts," says Lyle Simonton, Director of Business Development. "It's a double-decker bridge on the Missouri side of the Mississippi River and we've been working on it since the late 1990s. We'll be done within two years."

The company is becoming increasingly busy with ground improvement services. "We're starting to see more private work, not full force yet, but a lot more activity than a year or two ago," says Simonton.

Another soil mitigation technique involves earthquake drains. During an earthquake, loose, sandy soils can liquefy, causing damage to structures supported by the soil. By providing drains, pore pressures can be dissipated before they reach dangerous levels. Hayward Baker, Inc. (**www.haywardbaker.com**), headquartered in Odenton, Maryland, has acquired the rights to patented earthquake drains with the recent purchase of Nilex Construction (now HB Wick Drains). These drainage elements are installed vertically into the ground on a grid pattern, according to Director Jim Hussin.

"In applications where structures are less sensitive to settlement, or where the soils are only marginally liquefiable, earthquake drains alone can be effective," says Hussin. "For more sensitive structures, Hayward

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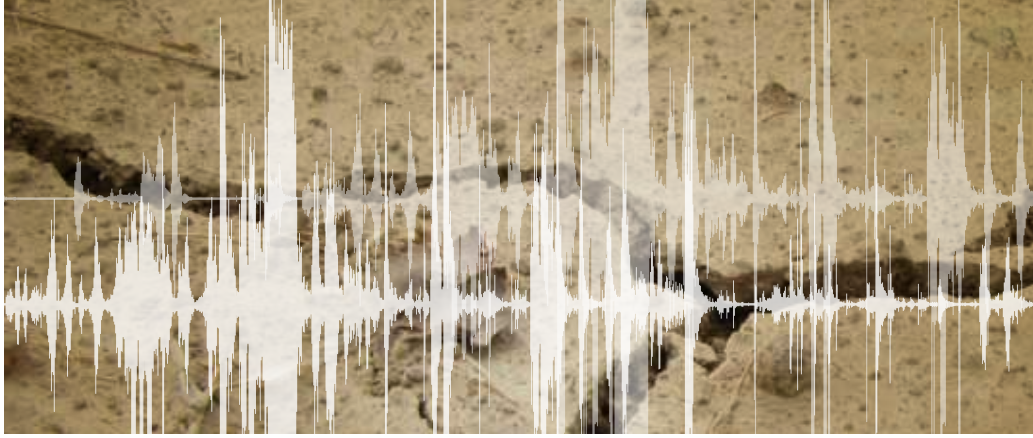

Baker can now offer more economical treatment programs which combine earthquake drains with traditional densification techniques, such as vibro-densification with large down hole vibrators, or compaction grouting. A third manner in which liquefaction can be mitigated is by reinforcing the soils with stiff elements that carry the seismic shear stresses."

Inclement weather and slow funding has hampered projects, according to Steve Holdsworth, Vice President of Operations & Technical Manager at Barsplice Products, Inc. (**www.barsplice.com**), in Dayton, Ohio. He says his customers report that there are a lot of projects – both private and federally funded – that should have started by now. "Some of these projects have been delayed due to issues associated with funding and/or rising material costs. A number of projects have been re-bid several times already. Bad weather has also been a factor in delaying jobs."

Barsplice provides its customers with positive means of connecting reinforcing bars to create structural continuity. "Unlike rebar lap splices, which depend upon the presence of surrounding concrete to transfer load from one piece of bar to the next, the installed strength of our mechanical splice devices is independent of the concrete." He adds: "For seismic design, I think that structural engineers should know that they have some great choices of Type 2 mechanical splice devices which, by definition, are designed to develop the specified tensile strength of the reinforcing bar. Under severe overload conditions, Type 2 mechanical splices are designed to hold the reinforcing bars together through the yield point of the bars, thereby permitting the adjoining bars to plastically deform and absorb seismic energy."

Holdsworth sees mechanical splicing systems as part on an evolutionary process, driven by changing code requirements and innovations. "Our business was founded on the use of cold-swaged BarGrip couplers, which are installed in the field by hydraulic presses. For many years, the BarGrip family of couplers has provided great opportunities, when compared to the lapping of bars. For example, by eliminating the lap in columns, designers can reduce column sizes and create more floor space in office buildings and apartments. Recently, the Zap Screwlok system was invented to overcome the problem you can have when reinforced concrete designs become congested and it can sometimes be tricky to maneuver a swaging press into place. The Zap Screwlok splicing system derives its strength from screws that are tightened through a coupler body onto the rebar. The heads of the screws twist-off at a prescribed torque value."▪

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