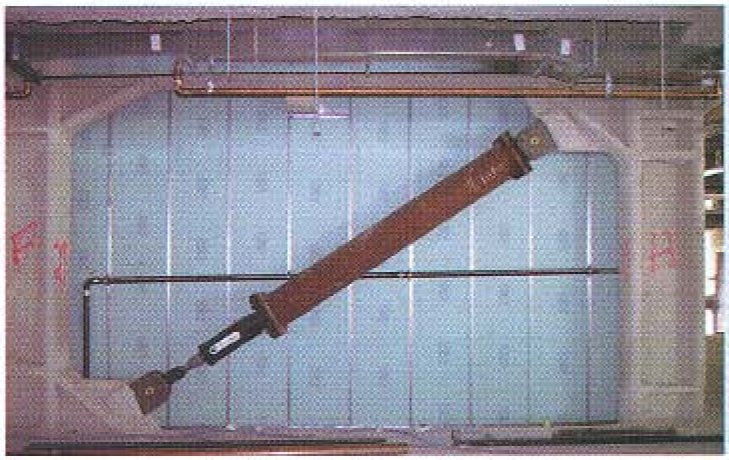
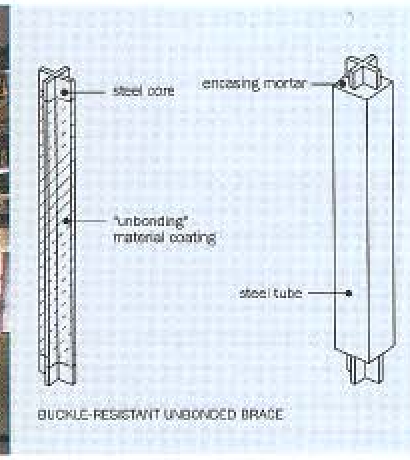




THE UNBONDED BRACE, LONG POPULAR IN JAPAN, MAKES ITS AMERICAN DEBUT

To preserve a building and its contents in the event of an earthquake, American structural engineers specify base isolators with braces—the most expensive system available. But the unbonded brace, according to Eric Ko, a structural engineer with Ove Arup & Partners in San Francisco, is poised to replace base isolators as the Cadillac of seismic systems, and it's reasonably priced.

Developed and manufactured by Nippon Steel Corp., the unbonded brace consists of a concrete-filled steel casing with a steel core shaped as a cruciform or flat bar that's coated with debonding chemicals to let it slip freely inside the casing. The concrete keeps the core from buckling, enabling the braces to perform well in tension and compression.

"Technically, the unbonded brace is a damper," Ko says. "It's the world's largest seismic shock absorber." Like dampers, the unbonded brace absorbs the energy of the seismic forces with a slipping action that protects the main frame. "It's intended to last through multiple quakes. That differentiates it from other bracing systems," he adds, "which, when they deform, drag along the floor plates they're connected to."

Used extensively in Japan during the past 10 years, the unbonded brace is being introduced in the States at the Plant and Environmental Sciences Replacement Facility, now under construction at the University of California at Davis (bottom right), designed by Zimmer Gunsul Frasca. The three-story, 125,000-square-foot building, which contains teaching labs, offices for researchers, and conference rooms, will be completed in late 2001.

"After deciding to make this a steel-frame building, we explored our seismic options," says Doug Reimer, AIA, project architect. "The unbonded brace is well tested. There's no question of how it will function." In fact, the Japanese are using unbonded braces exclusively in structures as tall as 750 feet.

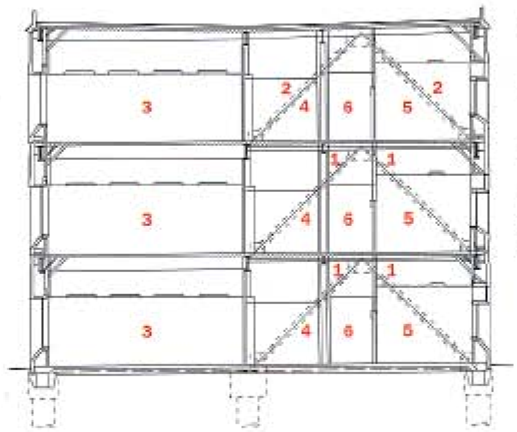
The braces are located throughout the building. "They are really no different from ordinary braces in terms of location and configuration," Reimer adds. Architecturally, any type of bracing is problematic if the programming is not consistent from floor to floor. "We put tremendous effort into putting the braces where they wouldn't hinder the flexibility of the labs," he says.

There is, however, another distinct advantage: unbonded braces are so effective at absorbing earthquake energy that they can be very slender. In this case, they are 12 inches square on the first two floors and 10 inches square on the top floor. Standard bracing of a similar performance level would be "enormous," Ko says.

The size and shape of the center core depends on the strength that is required. The stronger cruciform core is used on the two lower floors of the Davis facility, while a flat-bar core is used on the top floor.

Cost may prove the brace's biggest advantage. Reimer's bids put the cost, including construction fees, at about one-half percent of the total construction cost. "This was still competitive, and the cost is likely to come down as the braces are more widely adopted," he says.

Unbonded braces are too new for inclusion in U.S. building codes. The Davis facility is being treated as a "special case," Reimer says. If it meets approval, there is a good chance the bracing system will be adopted into code in 2003.
Wendy Talarico



1. *Cruciform-core unbonded brace*
2. *Flat-bar core unbonded brace*
3. *Laboratory*
4. *Laboratory support*
5. *Office*
6. *Corridor*