EARTHQUAKE ENGINEERING

Unbonded Brace Frames Debut At University of California

OVE ARUP & PARTNERS

UNBONDED BRACE *frames installed in a new building on the campus of the University of California at Davis are capable of withstanding several earthquakes.*

Structural engineers who design buildings in high-risk seismic zones may want to consider using the unbonded brace frame, which has seen extensive use in Japan but is only now being used in the United States. The first building in this country to use the unbonded brace is under construction at the University of California at Davis.

The 125,000 sq ft (11,600 m^2), three-story Plant and Environmental Sciences Building, which is scheduled for completion late in 2001, will contain 132 unbonded brace frames. The frames are bolted to the structure as diagonals or chevrons and do not require welds, according to Eric Ko, a senior associate in the San Francisco office of Ove Arup & Partners, a consultant to the university. The cost of the system is about 0.5 percent of the cost of the building, Ko says.

The buckle-resistant unbonded brace consists of a steel core—either a flat bar or a cruciform, depending on strength requirements—coated with debonding chemicals and surrounded by a concrete mortar. The frame is encased in a steel tube or rectangular casing.

The key to the unbonded brace frame is determining the correct thickness of the debonding agent. If the tar-like substance is too thick, the unbonded brace can buckle, Ko says. The steel core performs well in compression or tension because it is allowed to slip past the concrete mortar in the casing.

The unbonded braces are designed to withstand several earthquakes before major repairs would be necessary. "Conventional brace frames buckle in compression," Ko says.

The new building is designed to withstand between 4.5 and 5 in. (114 and 127 mm) of lateral movement. The expected lateral movement during the design earthquake is half the capacity of the brace, Ko says. Stronger cruciform unbonded braces are being used on the bottom two floors, with flat bar cores featured on the top floor.

A major advantage of the unbonded brace frame compared with the traditional brace frame is thickness. The cruciform braces are only 12 in. (305 mm) wide, and the flat bar braces are 10 in. (254 mm) wide.

According to Ko, more than $500 million in construction scheduled for the Bay Area will use the unbonded brace system. ▼