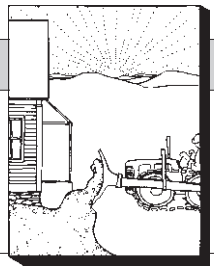

# Shake And Bake

by Kathleen O'Brien

Earlier this year, builder Tom Ossinger of Nordevin Inc., in Puyallup, Wash., got a demanding assignment: Go to Japan and build a 32,000-square-foot, 27-unit building out of wood, three stories tall. The structure, which was contracted by the American Plywood Association and dubbed the "Super House," would also have to bear the burden of proving to Japanese code officials that American-style wood-frame buildings can withstand earthquakes and fires.

### Getting a Foot in the Door

In the United States, of course, a three-story wood-frame building is no big deal. But in Japan, earthquake and fire are major concerns, and Japanese codes, which are overseen by the Japanese Ministry of Construction (MOC), have long prohibited wood-frame structures over two stories high — tremendously frustrating the American wood products industry. It was only recently that the American wood products and building industries were able to convince Japan to allow smaller multi-unit structures to be built of wood — up to 1,000 square meters (roughly 11,000 square feet) as of April 1992, and up to 3,000 square meters (about 32,000 square feet) as of April 1994. However, it seemed clear to the Americans that the Japanese still had reservations.

The APA, anxious to erase any doubts, struck a deal with the MOC: If the MOC would grant a code exception allowing the full project to be built before the April 1994 code change, the APA would construct a full-scale, three-unit "slice" of the Super House to demonstrate the durability of wood-frame construction under seismic and fire stresses. To simulate a one-two punch of earthquake followed by fire, the building would be subjected to a "shake and bake" test, as Ossinger calls it — it would be first pummeled by battering rams, then set aflame.

The APA took the challenge. The mockup's dimensions were 40 by 24 feet. Nordevin framed the first floor with 4x4 beams, 3 feet on-center, and 2x4 joists, 3 feet on-center in the spaces between the beams. He used the more standard 2x10s at 16 inches on-center for floor joists on the second and third floors. He framed the exterior walls with 2x6s on the first floor and 2x4s on the second and third floors, covered on the outside with 1/2-inch plywood and particleboard siding, and on the inside with 1/2-inch gypsum board. Interior walls were covered with two layers of 1/2-inch gypsum board; ceilings with one layer. Finally, to provide earthquake resistance, Nordevin placed 1/2-inch foundation anchor bolts every 6 feet.

Though clearly demanding, these specs were not significantly more demanding than most seismic and fire codes in the U.S.

### Test Time

Once completed, the building was pressurized to measure its tightness. Then hydraulic battering rams whacked, slammed, and pulled the second and third floors with lateral forces of up to 75,000 tons. They shook the building until the second story moved about 2 1/2 inches, and the third story about 3 1/2 inches. While such testing can't be directly correlated to earthquake strength, Ossinger says this part of the test simulated the effect of an earthquake measuring "about 7 points on the Richter scale" — roughly the strength of the 1989 San Francisco Bay Area quake.

The building was then repressurized to note any changes in air leakage — a key factor in fire spread. The changes found were negligible.

Then they torched it.

Dave Tyree, Northwest regional manager for the American Forest and Paper Association (formerly the National Forest Products Association), witnessed the test and says the building performed "above expected levels." The testers had to shake the building longer and harder than expected to cause the desired deflection, and even then, they found no structural cracks.

But it was when the place was set aflame — a pile of newspapers behind a first-story couch was ignited and the fire allowed to spread — that the structure really showed its resilience. The fire, fueled mainly by the furnishings on the first floor, spread rapidly and burned hot. For 20 minutes it grew, blowing out the windows on the first floor so it could shoot flames and smoke skyward.

But after the first half-hour, says Bob Glowinski, communications manager for the National Forest Products Association, "the fire took a siesta." With its fuel exhausted, and unable to burn through the gypboard, the fire merely smoldered. For another half an hour everyone watched, waiting for something to happen.

Finally, after 72 minutes, the MOC officials grew anxious to see the fire spread to the second floor. They ordered the fire department to break the second-story windows and cut holes in the floor between the first and second stories. Only then, says Glowinski, did the fire pick up and spread to the second floor.

"After 90 minutes," says Glowinski, "it was pretty obvious that the building deserved more than the standard one-hour rating. The Super House clearly demonstrates that code changes allowing construction like this are appropriate."

Ossinger added, "These changes could open the door to more wood-frame construction in Japan, using U.S. products and expertise. And that's what we're after." ■

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*To convince Japanese code officials that three-story wood-frame construction can stand up to earthquake and fire, the American Plywood Association built a mockup of a large multi-unit project — just so it could be shaken and burned.*

*Despite an impressive amount of smoke, the fire did not spread from the first to the second floor until after 72 minutes, when firefighters cut holes between the two floors.*

*After the mockup passed the fire test, the real thing was built. It provides apartments for middle managers of Mitsui & Company, the owners of the building.*