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Study says quake's first waves denote magnitude

Warning system cost prohibitive

By Becky Oskin, Staff Writer

PASADENA – Though an earthquake's first tremors often pass without notice, scientists say they now can estimate the size of coming quakes based on this early bump and rattle an important step toward building an earthquake early warning system in Southern California.

With a warning system in place, alarms could give people a few seconds to find shelter, shut down machinery and pipelines, slow trains and abort aircraft landings.

However, even the researchers responsible for the study say it would take an enormous investment in training and technology to make the system a reality.

"There's a big distance between technological development and actual implementation,' said Caltech seismologist Hiroo Kanamori.

Kanamori and Richard Allen, a geophysicist at the University of Wisconsin in Madison and leader of the study, modeled the warning system on Southern California's dense network of 155 seismic monitors. Their results appear today in the journal Science.

The method does not predict quakes. It relies on the time lag between different types of earthquake waves.

The energy released when one block of rock slips past another during an earthquake travels in more than one way. One type of energy travels as a P-wave, which moves the ground in a push-and-pull motion. At the epicenter, the P-wave moves outward simultaneously with the more damaging S-wave, which shakes up and down and side to side.

"The P-wave is usually very small, but it carries all the information regarding what happened at the source,' Kanamori said. Because an S-wave travels more slowly than P-wave, the S- wave arrives later at areas some distance from the epicenter.

Many people feel this gap as a quiet period between the slap of a P-wave and the violent shaking caused by S-waves.

Devising a system that can calculate an earthquake's magnitude from a P-wave in just a few seconds was the fundamental step achieved by Allen and Kanamori.

"This is something that was not known,' said Lucy Jones, a seismologist and scientist-in-charge at the United States Geological Survey's Pasadena office.

"This gives us a piece of information about the size of a quake in the first few seconds. That's important, but it doesn't give us a practical system,' said Jones, a member of the

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state's Seismic Safety Commission.

Early-warning systems in Japan and Mexico rely on the great distance between major cities and the epicenters of large earthquakes.

Mexico City is about 185 miles from the source of its most damaging quakes, near the Pacific coast. A network of seismometers there gives the city 70 seconds to prepare.

Because Southern California is built above its most dangerous faults, the warning times offered by Allen and Kanamori's system would be much shorter.

Someone 18 miles from the epicenter of the 1987 Whittier Narrows quake would experience an eight-second delay between passage of the P-wave and the S-wave.

Much of that delay would be used in detecting the P-wave, sending the data to a central processors, calculating the location, origin, time and magnitude, then disseminating the warning.

With a significant investment in telemetry and electronics, it is possible to reduce all of that to a few seconds. Allen and Kanamori are now testing their method in real-time to gauge the possibility.

"People who need warning the most will have less time, but at least the system can give people a chance to react,' Allen said.

"In an earthquake, every second counts.'

But Kanamori points out the difficulty of training millions of people to react to a warning that may come once in a lifetime.

"Maybe people can react quickly enough to take cover, but I can't. I was sitting here (in my office) during Whittier Narrows. All the ceiling tiles came down and I just watched.'

The most practical option would be linking the warning system to building monitors and utility company controls and infrastructure. Engineers in Japan are designing skyscrapers that can stiffen or soften in reaction to earthquake warnings, Kanamori said.

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