Quake hit hardest in S.F., Oakland, report says

By Glennda Chui
Mercury News Science Writer

Scientists at the United States Geological Survey have confirmed that the worst shaking in the Oct. 17 earthquake took place not at the epicenter, but more than 60 miles away in Oakland and San Francisco.

The preliminary report on the quake's intensity also confirms what scientists have been saying for weeks: that as bad as the damage was near the epicenter in the Santa Cruz Mountains, it was not nearly as bad as what is expected in the so-called Big One.

Near the epicenter, things shook with an intensity of 8 on the Mercalli scale, which estimates the strength of ground shaking in particular locations on the basis of the actual damage it produced. Intensity 8 means the shaking was strong enough to cause considerable damage in "ordinary, substantial buildings."

But at three distant spots — the Marina District and the Embarcadero Freeway in San Francisco and the Cypress Street Viaduct in Oakland — the shaking reached intensity 9. That's strong enough to damage structures that were designed to resist earthquakes.

It's also the intensity expected over much of the East Bay and South Bay in an earthquake scientists consider likely to be the next Big One — a 7.5-magnitude quake as measured on the Richter scale — along the Hayward Fault. Unlike the Mercalli scale, the Richter scale measures the magnitude of the

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"At least I had legs. I thought . . . at least somebody will have something to work with."

A new chapter in life

Challenges at home await Cypress survivor

By Pamela Kramer
Mercury News Staff Writer

As the Bay Area rebuilds the homes, highways and businesses shaken by last month's earthquake, Cathi Scarpa is rebuilding her body.

The 36-year-old Alameda nurse, whose legs were crushed in the collapse of the Cypress Street Viaduct, finished laying the foundation for that task Saturday when she headed home after more than five weeks at a Castro Valley hospital.

"How I've been trying to look at all this is in chapters," Scarpa said at a hospital press conference punctuated by tears. The first chapter was the earthquake. Then came several chapters of progress — like learning to get in and out of her wheelchair.

"Now, today's a new chapter starting," she said. "Today I'm going to find out how do I get to the bath-

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Quake shook hardest 60 miles from epicenter, report says

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quake at the epicenter. The Loma Prieta quake was 7.1 on that scale.

To compile their report, scientists from the U.S. Geological Survey and its National Earthquake Information Center in Golden, Colo., flew in to survey the damage in the wake of the Oct. 17 quake.

In general, the farther you are from the epicenter, the less the ground should shake, said Paul C. Thenhaus, a research geologist who led the team.

But in the real world, the amount of shaking in a given location is heavily influenced by the type of ground beneath it.

This was dramatically demonstrated in 1985, when an earthquake destroyed buildings in Mexico City, 200 miles from its epicenter. They were standing on a soft, thick former lake bed that amplified the shaking.

"What we saw in San Francisco was a scaled-down version of that," said Thenhaus. "That's almost a picture-perfect case for ground amplification."

The three areas of worst damage all rest on soft mud around the margins of the bay, he said.

Much of the damage in the Marina has been blamed on the wet, sandy fill beneath it, which turned to liquid during the quake and caused buildings to settle, tilt and collapse.

But Thenhaus said that's not the whole picture. Some buildings apparently were damaged by severe shaking alone, which may have been amplified by a thick layer of soft mud beneath the fill.

Scientists from USGS in Menlo Park recently discovered that this mud was much thicker than previously thought — up to 240 feet thick, rather than about 20 feet.

The three areas of worst damage all rest on soft mud around the margins of the bay, according to one of the report's authors.

Thenhaus said the team's estimate of the intensity of shaking in the Marina may change as it continues to collect and refine observations.

The Bay Bridge, which partly collapsed during the quake, was conspicuously absent from the report.

That's because the collapse involved only a 50-foot section, too small a scale for the map, said Edgar V. Leyendecker, a structural engineer on the team. If it had been included, he said, it would have been considered evidence of an intensity 9 shaking.

Last week, some members of the team returned to the Monterey Bay area to gather more information on the damage there.

The Earthquake Information Center has also sent out 1,300 questionnaires to police stations, fire stations and postmasters throughout California, as well as parts of Nevada and southern Oregon, asking them to record their observations of the quake.

The forms, about the size of a greeting card, contain about 75 questions on quake damage: Were windows cracked or broken out? Were dishes broken? How many? Were the cracks in the plaster hairline or larger?

Carl W. Stover, head of the center's U.S. Earthquakes Project, said he is compiling the responses by hand and reading newspaper accounts to get a more complete picture of the damage patterns. Based on that information, a new intensity map should be drawn up within a few weeks. While it will be more detailed, it should contain no major changes, he said.

The final version — the one that will live as the official account of what happened during the Loma Prieta earthquake — won't come out for at least two years, Stover said. That's how long it will take for the official data from scientists and engineers to be incorporated and published.

These maps are important, Thenhaus said, because they help scientists to understand how ground shaking is related to magnitude in a given earthquake.

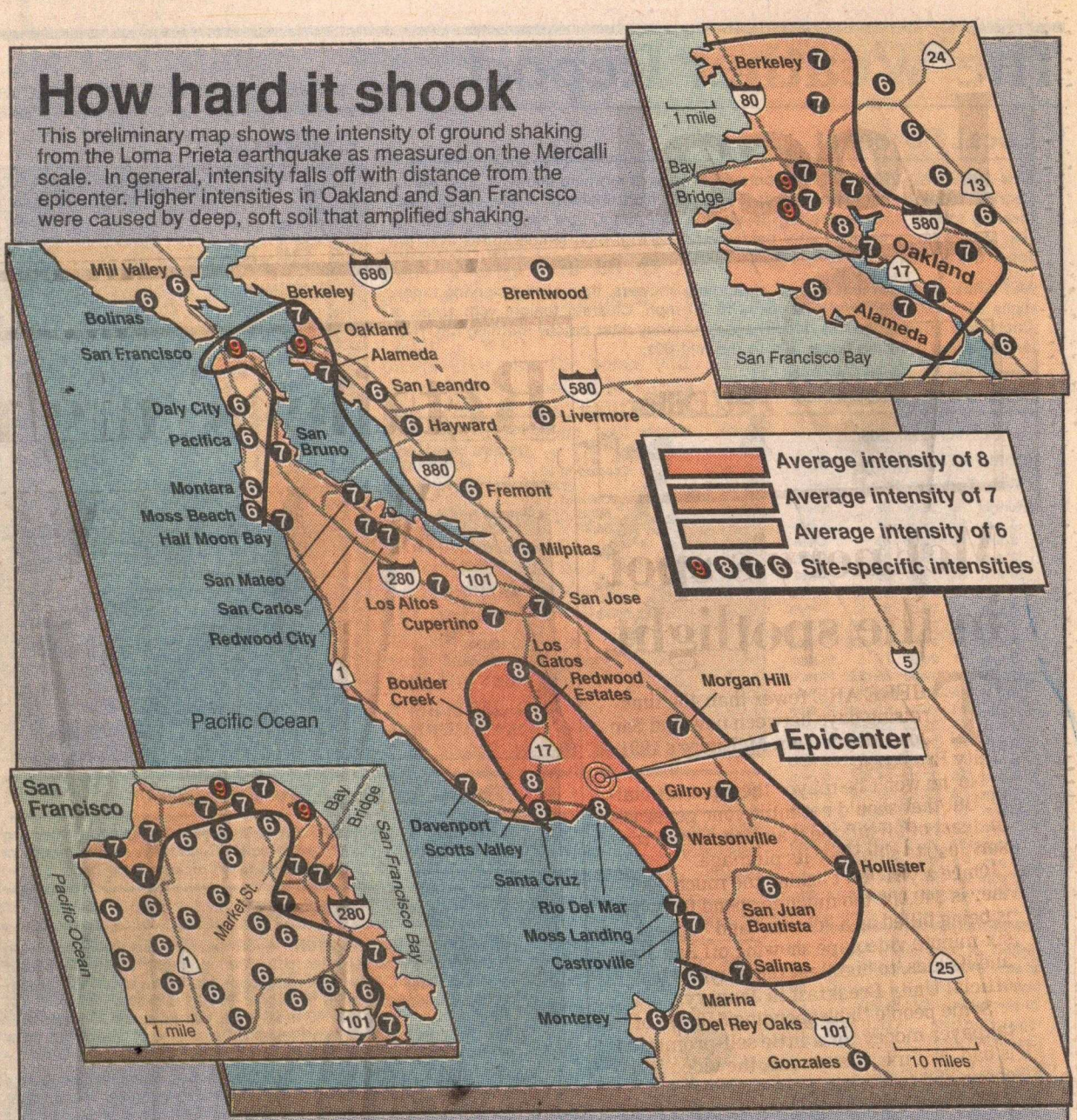
Many big earthquakes in the United States took place before the 1880s, when the first seismometers were installed to record shaking. So scientists don't have any direct measurements of magnitude; they have to make educated guesses, based on accounts of damage that are translated into intensities on the Mercalli scale.

Thenhaus said the intensity maps are also used by the insurance industry to predict earthquake losses, and by public officials for disaster planning. "They can use these directly to anticipate how much and how widespread the damage will be from a particular earthquake," he said.

EARTH Quake - Geological

How hard it shook

This preliminary map shows the intensity of ground shaking from the Loma Prieta earthquake as measured on the Mercalli scale. In general, intensity falls off with distance from the epicenter. Higher intensities in Oakland and San Francisco were caused by deep, soft soil that amplified shaking.



The Mercalli scale of earthquake intensity

1. Generally not felt.
2. Felt indoors by few.
3. Felt indoors by some as rapid vibration; hanging objects may swing slightly.
4. Felt indoors by many, outdoors by few. Windows rattle, walls creak, hanging objects swing.
5. Felt indoors by practically all, outdoors by many or most. Buildings tremble, dishes break, small furnishings move slightly.
6. Felt by all, frightens many. Damage is slight. Some windows break. Furnishings move or overturn.
7. Frightens all. Difficult to move. Damage negligible in buildings of good design and construction, considerable in poorly built or designed buildings, old walls, spires. Weak chimneys break at roof line. Many windows break. Brickwork and tiles fall. Heavy furniture overturns.
8. Widespread fear near the point of panic. Tree trunks and branches break off. Damage slight in buildings built to withstand earthquakes, considerable in ordinary substantial buildings. Buildings break off pilings. Walls fall. Heavy furniture overturns.
9. Panic general. Damage considerable in masonry structures built to withstand earthquakes. Damage great in other substantial masonry buildings; some collapse or shift off foundations. Also damage to wood-frame structures. Some underground pipes break.
10. Most masonry structures destroyed. Damage severe to well-built wooden structures.
11. Significant tsunamis, or tidal waves, form. Damage is severe to wood-frame structures. Few if any masonry structures left standing. Dams badly damaged. Piers of large, well-built bridges collapse. Railroad rails badly bent.
12. Damage total — practically all construction heavily damaged or destroyed. Water channels are modified substantially. Ground waves visible. Objects thrown upward into air.

Source: U.S. Geological Survey

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