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 From the Los Angeles Times

## State Called Unready for Big Quake

Scientists marking 1906 disaster say future toll could be worse because of surging population and development and lack of retrofitting.

By Sharon Bernstein  
 Times Staff Writer

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SAN FRANCISCO — New research on earthquakes presented this week to mark the 100th anniversary of this city's great quake paints a disquieting picture of California's preparedness for a major temblor.

The overarching message of scientists gathered here was twofold. First, future quakes could easily do more damage than past ones because the population of California continues to increase and there are more buildings in areas near fault lines on soft ground susceptible to liquefaction. Second, the state must do more to retrofit vulnerable buildings.

A landmark study presented Thursday by noted structural engineer Charles Kircher found that 5% of buildings would cause 50% of the deaths in the event of a major temblor.

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Those buildings include unreinforced masonry, brittle concrete structures and buildings with open floor plans on the first floor, such as apartments with first-story garages or retail businesses.

Seismologists and state officials have long warned of the danger of such buildings, but regulating them has been difficult. Though some retrofitting has occurred on old brick buildings, relatively little has been done about so-called "nonductile" concrete buildings and "soft" first-story buildings despite their proliferation across the state.

Kircher's research is considered significant because it pulled together several disciplines.

He determined damage estimates by studying areas that earthquake waves would strike if the 1906 temblor occurred now, and then cross-referencing that data with information on where vulnerable buildings are located. Those facts then were combined with insurance industry estimates on the cost of replacing buildings and census data on how many people lived there.

Kircher said that unless thousands of buildings are upgraded to meet the newest earthquake standards, as many as 3,400 people could die if a magnitude 7.9 quake struck Northern California. That's more than twice the number of deaths caused by last year's hurricanes Katrina and Rita combined.

There would be \$1.5 trillion worth of damage to buildings and property — far more than the \$125 billion estimated so far for the two hurricanes — and up to 13,000 people would require hospitalization, his study found.

Kircher spoke at the first ever convocation of scientists, engineers, disaster preparedness officials and politicians that met in San Francisco this week to commemorate the 1906 temblor.

His report was one of several scientific papers that highlighted the state's quake vulnerabilities as well as efforts to improve preparedness.

Tom Jordan, director of the Southern California Earthquake Center, presented information about a project his group is working on that attempts to predict where earthquake waves would travel when a temblor hits the region.

The group is examining various faults across Southern California and hopes to estimate the areas that would be hit hardest. With such information, safety officials could consider special measures in particularly vulnerable areas.

Contrary to some earlier theories, which posited that there would be less shaking farther away from the epicenter, scientists have learned in recent years that the type of soil can play a greater role than the distance from the rupture.

Another important factor is the direction of the break itself. If the San Andreas fault were to break near Santa Rosa and the rupture traveled south toward San Francisco, the Bay Area would be harder hit than if the break occurred closer to San Francisco but traveled north.

Another study — by several organizations including the U.S. Geological Survey, UC Berkeley and Lawrence Livermore National Laboratory — allowed scientists to replicate the seismic wave patterns of the 1906 temblor, pinpointing the areas that would be hit hardest if the quake occurred today.

Peggy Hellweg, director of the Berkeley Seismological Laboratory, said the study showed that the most vulnerable areas would be those built on fill or located in basins, including Emeryville, Berkeley, Richmond, Alameda and several districts in San Francisco, including the marina.

"There are going to be a lot of places where the shaking is unpleasant," Hellweg said. "There will be many places where the shaking will be bad, and there will be a number of places where it will be really terrible."

Policymakers, she said, should use this research — along with similar studies from Southern California — to identify areas where shaking will be the worst and upgrade buildings in those areas first.

Ellis Stanley, head of emergency services for the city of Los Angeles and an attendee at the conference, said he has already begun preparing for local infrastructure and building failures.

Among other things, he is developing plans for mobile tent hospitals to care for the thousands of people who might be injured in a major quake if — as anticipated — local hospitals that have not been retrofitted fail when the temblor strikes.

Other research, by UCLA seismologist Monica Kohler, uses instruments to record precise images of how various parts of a building move when subjected to shaking.

In the future, Kohler said, such information could be used after a temblor to more easily pinpoint just where in a large building damage may have occurred, making it easier to find and fix potential safety problems.

As with much of science, there are many areas where data appear to conflict — and scientists differ on their meaning.

Today attendees were scheduled to discuss one such area of disagreement: the value of efforts to provide early warnings of earthquakes.

One scientist, Richard Allen of UC Berkeley, is expected to argue that such systems could give people anywhere from a few seconds to a few minutes to prepare for a quake — allowing time to duck and cover or dash outside.

But David Wald of the U.S. Geological Survey will say that such systems would be complex and difficult to manage, and that they might distract from greater challenges such as developing evacuation and response plans and upgrading buildings and infrastructure.

Richard Eisner, director of the earthquake and tsunami program of the California Office of Emergency Services, said it is those practical fixes — drawing up an integrated tsunami alert and evacuation plan and upgrading risky buildings — that will do the most to protect Californians from a significant temblor.

But considering the billions it would cost to retrofit thousands of at-risk buildings and the political opposition to requiring that work, Eisner said, those most practical steps may be the hardest for the state to take. "It's a matter of will," he said. "You have to go out and inventory the buildings and then you have to require strengthening."

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