Kobe disaster offers lessons for U.S.

The first engineers and scientists to visit Kobe, Japan, after last week's earthquake there blame a combination of poor planning and bad luck for the high number of fatalities, currently estimated at more than 5,000 people. They also note that some of the same problems plague quake-prone U.S. cities.

Although television cameras have lingered on the dramatic image of overturned highway sections, the moment magnitude 6.8 quake hit at 5:46 a.m., when people lay asleep at home. Most deaths in the Jan. 17 disaster resulted from the collapse of older homes and apartment houses, built before new construction codes took effect in 1981.

"The buildings designed after 1981 are not so severely damaged. Mostly there is no damage," says Teizo Fujiwara, a structural engineer at Kyoto University, who toured the damage.

The quake humbled Japanese engineers, who had previously boasted that their freeways could withstand even larger shakes. But they scored a success with high-rise buildings, which successfully rode out the vibrations.

The threat posed by precode buildings has a familiar ring to U.S. earthquake experts. "We have a real problem in California with existing buildings," says Susan K. Tubbesing, director of the Earthquake Engineering Research Institute in Oakland, Calif. Few cities have made any attempt to strengthen or eliminate hazardous older buildings, says Tubbesing. At the time of the earthquake, she was attending a conference on quake hazards in nearby Osaka, which suffered minor damage.

Many homes in the Kobe area were wooden structures with heavy tile roofs and little lateral support. When they collapsed, "they were just kindling for the fires," says Tubbesing.

The earthquake caught Kobe residents and emergency officials by surprise, even though geoscientists had mapped the fault that produced last week's quake. Because no sizable tremor had struck Kobe in recent memory, citizens in this port city did not consider quakes a hazard. "People in this area figured the earthquake problem was a Tokyo problem," according to Tubbesing.

That attitude may have originated with Japanese seismologists, who have focused most resources on trying to predict a major earthquake expected near Tokyo. Although earthquakes can rattle all parts of Japan, most scientists expected the next destructive shock to hit the capital city. "It's a kind of political problem," says one Tokyo geologist. "Most seismologists and geologists said on TV that we expected the [Kobe] earthquake to occur. But, honestly speaking, we were astonished."

Kobe also suffered from geologic bad luck, as the earthquake made a direct hit beneath the city. The tremor originated under nearby Awaji Island and then spread along the fault in two directions, one of which ran under Kobe, says Megumi Mizoue, a seismologist at the University of Tokyo. The shallow depth of the earthquake further enhanced shaking in Kobe.

Preliminary data collected by strong-motion recorders in the region indicate that the quake may have produced exceptionally strong vertical shaking. "The vertical component of the earthquake may have been very large compared with other earthquakes that have occurred in Japan," says Fujiwara.

In some places, vertical shaking appeared to equal or exceed the force of horizontal vibrations, Fujiwara says. If corroborated, the recordings of strong vertical accelerations in Kobe would match findings made last January in the Northridge earthquake near Los Angeles.

Measurements from both quakes suggest that engineers will have to revise their construction codes to account for the possibility of strong vertical accelerations, says Fujiwara. Japanese and U.S. engineers do not currently consider vertical shaking in the design of most buildings.

In Kobe, weak ground conditions also played a role in the destruction, according to many observers. Parts of the waterside city were built on soft natural sediments and artificial landfill, which can both amplify shaking and become liquidlike under certain conditions.

The Kobe quake raises concern about Oakland and other cities along San Francisco Bay, which face similar problems with poor soil. Like Kobe, Oakland sits atop a fault that can produce earthquakes of magnitude 7.0. "I really do hope we get our act together at home," says Tubbesing, an Oakland resident.

— R. Monastersky

Patterns provide clues to material makeup

Everywhere, nature reveals patterns. Whether one is discerning the weather from the shape of clouds or the quality of cottage cheese from the size of curds, objects in the physical world offer clues about their status in the form of simple, repeating shapes and textures.

"There's a strong connection between molecular properties and macroscopic patterns," says Michael Seul, a physicist at AT&T Bell Laboratories in Murray Hill, N.J. "To the extent that patterns are manifestations of underlying microscopic interactions, one can use them as indicators of a material's makeup and molecular ordering."

Reporting in the Jan. 27 SCIENCE, Seul and David Andelman, a physicist at Tel Aviv University in Israel, describe recent efforts to categorize and decode "domain shapes and patterns" in a wide variety of materials, ranging from superconductors to biological membranes. Examining both flat and three-dimensional shapes, they observe several kinds of "stripe" and "bubble" patterns in chemical systems to see what they reveal about a material's state.

The researchers contend that the widespread appearance of "equilibrium patterns," with common structures and evolutions, "suggests a possible universal mechanism to account for the formation of these textures."

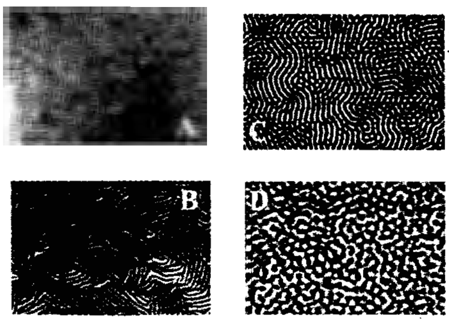
"Think of it this way," Seul says. "Each pattern offers a solution to many different problems that a chemical system is trying to solve at the same time. It represents a compromise between competing physical forces."

A system with many components may "try to do different things at the same time," Seul adds. "On one hand, molecules that are alike may try to fit together. On the other hand, electrical repulsions may keep them apart. So the solution emerges as a spatially alternating pattern."

The researchers maintain that the ability to decode shape distortions may have diagnostic value in the design and manufacture of materials. In ceramic mixtures, for instance, pattern deformations may signal coarsening and separation of a material. In other cases, alternating spirals can reveal details about the chirality, or handedness, of molecules in a blend.

As for using domain patterns to predict material qualities, Seul says he sees "strong possibilities."

— R. Lipkin



Seul, Andelman/SCIENCE

Stripe domain patterns: (A) alternating superconductivity in a foil; (B) ripples in a phospholipid vesicle; (C) Turing patterns in a chemical system; (D) convective rolls in carbon dioxide.