

✓ C F Earthquake 1989 - Geological RP 10/30/90 p. 3  
Judge David Kenyon after psychiatric public defender in Los Angeles.

# '89 quake damage traced to '06 repairs

DALLAS (AP) — The heaviest damage to gas and water lines in San Francisco's Marina District during the October 1989 earthquake occurred in areas where fine, silty sands were used to create level ground for the 1915 World's Fair, a geologist says.

Michael J. Bennett, a geologist with the U.S. Geological Survey in Menlo Park, gave the report in a paper presented today to the Geological Society of America's annual meeting.

Bennett said that the engineering practices that made it possible for San Francisco to host the 1915 Panama-Pacific International Exposition less than a decade after the 1906 earthquake also were responsible for much of the damage to the city's underground utilities

on Oct. 17, 1989.

Seventy-five years ago, Bennett said, San Francisco prided itself on its quick recovery from the 1906 disaster and erected numerous buildings on the site to house the exhibits. When the exposition closed, the site was vacant until 1924, when it was sold to developers who began construction of multi-resident buildings.

Before 1912, Bennett said, the area was depicted on maps as a shallow cove of San Francisco Bay.

In the paper, Bennett described how liquefaction that occurred during the 1989 earthquake was primarily restricted to areas underlain by saturated artificial fills that experienced settlement dur-

ing the earthquake, withdrawing support from the buried pipelines.

Bennett explained that liquefaction is a process that transforms loose, water-saturated sand into a sand-water mixture of very low strength. Seismic waves disturb the soil structure and increase pressure on the mixture, erupting some of it to the surface as "sand boils" that resemble miniature volcanoes.

Particles in the Marina sand boils of 1989 were similar in color and grain to those in samples obtained from the 1912 hydraulic fill, Bennett said.

The naturally occurring beach and dune Marina District have a high resistance to liquefaction, thus explaining why pipeline dam-

age was limited to areas underlain by the hydraulic fill, Bennett said.

Most damage to buildings in the area was caused by strong ground shaking and inadequate seismic resistance in the structures, rather than liquefaction.