

DAMAGE REPORT OF THE LOMA PRIETA EARTHQUAKE ON OCTOBER 17, 1989

by

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A strong earthquake of Ms=7.1 occurred in Santa Cruz Mountains of northern California at 5:04 p.m., October 17, 1989. About 40km of the San Andreas fault slipped with about 1.8m horizontal and 1.2m vertical displacements. Extensive damages were reported in the San Francisco Bay Area as well as the epicentral region.

Two weeks after the earthquake, five faculty members of Institute of Industrial Science flew to San Francisco to investigate various damages due to the earthquake. This news letter shows typical damages of buildings, transportation facilities and lifeline structures.

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Photo 1. The slab of the Narrow Bridge of California State Highway 1 fell onto a wet low ground in Watsonville where many wooden and masonry buildings in the downtown area were severely damaged. The slab was punched by RC piles with diameter of about 37cm.



Photo 2. Water tanks by the Summit road running along the San Andreas Fault were severely ruptured. The 20,000 gallon water tank was shifted in the direction of $N75^{\circ} E$ about 120cm on the timbers. The bottom plate of the 18,000 gallon water tank in the background was peeled off from the concrete foundation.



Photo 3. The backfill of the container pier in the Port of Oakland was settled about 1 to 1.5 feet resulting in cracks of piles supporting this pier and a tilt of cranes with their sea-side wheels on the pier and inshore-side wheels on the backfill.



Photo 4. There are about 7 dams in the area within the epicentral distance of 20km. All of them are of fill-type and minor damages on these dams are reported. Longitudinal cracks are running on the Anderson Dam ($\Delta=20\text{km}$) where the maximum horizontal acceleration was 0.43g on the crest and 0.23g at the downstream recorder site.



Photo 5. Three major substations, Metcalf, San Mateo and Moss Landing, were severely damaged in their switchyards, then about 1.4 million customers lost electric power. Top heavy circuit breakers turned over and oil leaked from transformers. (From the video tape of PG&E)



Photo 6. A prestressed concrete water tank broke from top to bottom and the full storage water flew out in Los Altos Hills. This tank of 1 mega-gallon was located unfortunately just above an extended fissure.



Photo 7. San Francisco's auxiliary water line broke at the south of Market Street. Due to the break of 12 inch high pressure line, water pressure of the fire fighting system dropped. Thus a fire boat was brought in for the fire fighting in Marina District.



Photo 8. In Oakland International Airport, 3,000 feet of the 10,000 feet main runway were severely damaged. An extensive cracking was developed and many sand boils were observed. However, the airport was kept open except for very large aircraft.



Photo 9. In Marina District, corner buildings were severely damaged. Most of them were 3 or 4 story apartment buildings in which the first story was taken up almost entirely by garages. The ground story had less lateral resistance than the upper stories and thus resulted in the "soft first story" behavior.



Photo 10. This relatively new reinforced concrete building at 4th and Harrison Streets in San Francisco had been strengthened and stiffened using steel brace systems before the earthquake. A large local buckle, however, developed in one of the brace systems and it was replaced immediately after the earthquake.



Photo 11. Shear cracks developed in the second story of a relatively new reinforced concrete building at Oak Street and Gough Street in San Francisco, mainly due to the presence of shear walls in the first story.



Photo 12. A steel frame building at Franklin Street and 17th Street in Oakland constructed in the early 1960s suffered major shear cracks in the lightweight concrete walls and columns. The damaged elements were under repairing when the investigation team arrived at the site.



Photo 13. An old reinforced concrete warehouse in Emeryville suffered severe shear cracks in beams, columns, and walls. A highrise building, which is several hundred meters away from this building, experienced a strong ground motion, with a peak acceleration of 0.22g at the ground floor.



Photo 14. Unreinforced masonry buildings in the epicentral region suffered severe damages and partial collapses such as out-of-plane failure in parapets and the upper portion of the wall. This building on the main street in Los Gatos was extremely deformed in the first story.



Photo 15. Another typical damage in the epicentral region was found in old wooden frame residential structures built on the cripple (or pony) walls of approximately 50cm high. These walls had poor lateral resistance and collapsed during the strong shaking.



Photo 16. Old buildings on the Pacific Garden Mall in Santa Cruz suffered most severe damages in the epicentral region. This seven story old reinforced concrete hotel (Palomar Inn) suffered crackings in all of the shear walls at the second story. A few people were killed in this area.