

For more information, contact: EERI  
6431 Fairmount Avenue, Suite 7  
El Cerrito, CA USA 94530-3624  
(415) 525-3668

#### CONTINUING EDUCATION COMMITTEE

#### SET OF SLIDES SHOWING EFFECTS OF THE OCTOBER 1, 1987 WHITTIER NARROWS EARTHQUAKE

Created by: Marshall Lew, (LeRoy Crandall and Associates), and  
Gregg Brandow, (Brandow and Johnston).

#### Foreword

At 7:42 a.m. local time on October 1, 1987, a moderate earthquake of magnitude 5.9 occurred in the east Los Angeles Metropolitan area. The epicenter of the earthquake was south of San Gabriel and just north of the Whittier Narrows flood control basin, between the San Bernardino and Pomona freeways (routes 10 and 60 respectively). The depth was estimated to be between 7 to 9 miles beneath the surface.

As in previous earthquakes, the Whittier Narrows earthquake primarily affected those structures which lacked adequate bracing against seismic forces. The damage to more than 10,000 public and private structures exceeded \$350 million. The full extent of the social and economic losses in the affected communities is not known and is difficult to measure because they it includes provision for shelter, counseling, and alternative housing for low-and moderate-income residents displaced by the earthquake; restoration of public works, buildings, and services; loss of income to businesses that failed after their structures were destroyed; and losses to businesses that were closed.

The earthquake took at least 4 lives, including those of a student at California State University at Los Angeles who was hit by a concrete panel that fell from a parking structure onto a walkway and a construction worker who was buried alive in a collapsing evacuation in the Angeles National Forest. Hospitals across the Los Angeles basin treated approximately 200 quake victims with minor injuries.

Reference: "Whittier 1987", Networks, a publication of BAREKPP, vol. 3, no. 1, 10 p.

#### INFORMATION FOR EACH SLIDE

##### Slide: WN 1

The Whittier Narrow earthquake ( $M = 5.9$ ) occurred at the northern tip of the Whittier fault, a secondary fault of the San Andreas system in southern California. The San Andreas fault system forms the boundary between the Pacific and North American tectonic plates in western California. Most of the relative motion between the Pacific plate and the North American plates in

southern California consists of horizontal slip, with the Pacific plate moving northwest on the average about 1.3 inches per year.

The epicenter was at the northwestern end of the Whittier fault zone, which is exposed at the surface and has been mapped by geologists over a distance of about 25 miles between the Whittier Narrows and the Santa Ana River to the southeast. Numerous small earthquakes have been located on or near the Whittier fault zone and considerable horizontal slip and under-thrust motion have occurred along it in recent time.

The seismological evidence indicated that the fault that broke in the Whittier Narrows earthquake was not a northern extension of the Whittier fault zone. Rather, the causative fault runs east-west, not southeast-northwest, and it was too deep to be a simple extension of the Whittier fault.

Slide: WN 2

This slide shows the epicenter of the earthquake (red circle and star) and the distribution of the aftershocks. As of October 19, 30 aftershocks of magnitude 3.0 or greater, 6 of magnitude 4.0 or greater, and 1 of magnitude 5.5 had been recorded. The epicenters of the aftershocks lie in a north-south belt about 2 miles wide and 4 miles long between San Gabriel and Pico Rivera. Their depths ranged from 6 to 10 miles.

\*\*\*\*\*

Slide: WN 3

This slide shows the preliminary distribution of Modified Mercalli (MM) intensity from the Whittier Narrows earthquake, as determined by U.S. Geological Survey in street-to-street surveys of the damage. The meaning of the MM intensity scale is:

- 1) VI: Felt by all; many are frightened and run outdoors. Some heavy furniture moved. A few instances of fallen plaster or damaged chimneys.
- 2) VII: Most people in buildings run outdoors. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly built design structures. Some chimneys broken.
- 3) VIII: Damage slight in specially design structures, considerable in ordinary substantial buildings, with partial collapse, and great in poorly built structures.

Based on the preliminary survey, the highest intensity was VIII in the downtown section of Whittier. The survey of housing units in the census tract that includes downtown Whittier indicated that a) 70 percent suffered damage to their chimneys, b) 70 percent suffered damage to their exterior finish, and c) 3 percent were moved on their foundations. A similar survey of similar housing units 1 mile west of Whittier showed that: a) 30 percent suffered damage to their chimneys, b) 75 percent suffered damage to their exterior finish, and c) only a few moved on their foundations.

The area experiencing intensity VII was approximately 100 square miles.

Slide:    WN 4

This slide shows damage to a parking structure adjacent to the May company.

\*\*\*\*\*

Slide:    WN 5

This slide shows a close up of the damage shown in the preceding slide.

\*\*\*\*\*

Slide:    WN 6

Downtown Whittier.

\*\*\*\*\*

Slide:    WN 7

Downtown Whittier

\*\*\*\*\*

Slide:    WN 8

Damage to a Whittier home.

\*\*\*\*\*

Slide:    WN 9

Damage to a Whittier home.

\*\*\*\*\*

page 4            Whittier Narrows

Slide:    WN 10

Chimney failure.

\*\*\*\*\*

Slide:    WN 11

Failure of a retained wall.

\*\*\*\*\*

Slide:    WN 12

Cal State Los Angeles - precast panel on ground.

\*\*\*\*\*

Slide:    WN 13

Cal State Los Angeles - precast panel connection.

\*\*\*\*\*

Slide:    WN 14

Cal State Los Angeles - library stacks.

\*\*\*\*\*

Slide:    WN 15

Collapse of building in east Los Angeles.

\*\*\*\*\*

Slide:    WN 16

Collpase of garage in Pasadena.

\*\*\*\*\*

Slide:    WN 17

Damage to tilt-up building.

\*\*\*\*\*

Slide:   WN 18

External view of California Federal Building.

\*\*\*\*\*

Slide:   WN 19

Internal view of California Federal Building.

\*\*\*\*\*

Slide:   WN 20

Damage to Cal Trans overpass.

\*\*\*\*\*

SUMMARY OF LESSONS LEARNED

1.   Don't count on earthquakes occurring only where they are supposed to occur.
2.   Non-structural damage can be severe and costly.
3.   Poor soils can cause a higher degree of damage, even when the site is miles away from the epicenter.
4.   Unreinforced masonry and precast concrete "tilt-up" type structures are vulnerable, especially if founded on poor soils.
5.   Unreinforced masonry structures pose a threat to life and property in moderate-to-great magnitude earthquakes.
6.   Bolting wood-frame structures to the foundation will greatly reduce or even eliminate a major cause of damage to wood frame buildings.
7.   Individual lifeline systems (bridges) can fail and disrupt regional transportation.