Engineering geology effects of the Borrego Mountain earthquake, April 9, 1968
Classification of effects modified after Richter (1958, p. 81)

Effects	Transient effects		Permanent effects			
	Map Symbol		Map Symbol	Direct or primary (due to fault movement)	Map Symbol	Indirect or secondary (due to passage of seismic waves)
Terrain	0.75 Z_1	Predominant direction of horizontal motion and duration of shaking, in minutes. Perceptible shaking experienced over entire area of plate 4. Visible surface waves		Fractures and offsets Pressure ridges Developed extensively along fracture zones; see Clark, this volume Scarps Developed along fracture zones that coincide with preexisting scarps; see Clark, this volume		Slope failures [1] Rockfalls Soilfalls Rockslides Slumps and incipient slump cracks (fissures generated in headwall regions of evolving slides) in natural materials Slumps in artificial fill Slumps in artificial fill along shoreline (canal, river, or lake) Shattered crusts; natural deposits Shattered crusts; artificial deposits Compaction features Cracked surficial deposits Faulted surficial deposits Sand boils Displaced pebbles or cobbles Collapsed animal burrows
Manmade structures			1 2	Deformed by bending, twisting, or rending Roads Pipelines		Damaged by shaking: Cracked highway Broken pipeline Collapsed or toppled chimney Cracked or partly collapsed ceilings Walls (masonry) Cracked Collapsed Walls (wood frame) Separated at joins with annexes Cracked plaster or wallboard seam Concrete slabs, liners, or pipes shifted or cracked Bridges Cracked or spalled piers Concrete deck cracked; abutments cracked or displaced; fill buckled or settled at aprons Anchored objects (housetrailers, washbasins) pulled or snapped from fittings or foundations Pounding at base of structure Occasional cracked window Swimming pool cracked
Loose objects	Q	Anchored objects (chandeliers, flagpoles, trees) swung or whipped				Automobiles or trailers shifted laterally Heavy objects (furniture, water heaters, safes) shifted or projected Heavy objects overturned Light objects shifted, projected, or overturned
Miscellaneous	Z_2 J A_1 A_2	Seiche in swimming pool or storage tank Experienced difficulty in walking Sand in water following shock Increased flow from well following shock			M	Automobiles damaged by falling rock

[1] Classification and terminology modified after Varnes (1958)

Locations of tectonic fractures from plate 1. Geology generalized from Strand (1962), Rogers (1965), and Jennings (1967). Data on earthquake effects compiled by R.O. Castle and T.L. Youd

Base from U.S. Geological Survey 1:250,000 San Diego, 1958; Santa Ana, 1965; Salton Sea, 1959; El Centro, 1964

MAP SHOWING GENERALIZED GEOLOGY AND DISTRIBUTION OF EFFECTS OF THE BORREGO MOUNTAIN EARTHQUAKE BETWEEN CORONADO AND GLAMIS, CALIFORNIA

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