REDUCING THE EFFECTS OF SEISMIC HAZARDS TO SEGMENTED AND JOINTED PIPELINES

Leon R. L. Wang
Old Dominion University, Norfolk, Virginia
and
Eiichi Kuribayashi
Toyohashi University of Technology, Toyohashi, Japan

Lifeline systems (water and sewer pipelines, oil and gas pipelines, electric power transmission lines, long-span bridges, etc.) have been damaged heavily by recent earthquakes, including the most recent September 1985 Mexico earthquakes. At the present time, scientists, researchers, and engineers in the United States, Japan, China, Mexico, and other countries are actively engaged in research concerning the adequate design of new lifeline systems and the retrofitting of existing lifelines.

Most water and sewerage lifelines are below-ground, segmented or jointed pipelines and it is on these that this paper focuses. There are some above-ground and continuous pipelines but they are mentioned only briefly.

Specifically, this paper describes damage to water and sewer pipelines in recent earthquakes including those in the United States, Japan, and China. It also describes available methods, criteria and techniques for pre-earthquake preparation, survey of damages, restoration and repair of damaged systems, design and construction of new pipelines, and retrofitting of existing ones. Ongoing activities in the advancement of knowledge regarding the behavior of segmented pipelines during earthquakes, problems and issues needing attention, and potential solutions are addressed.

BACKGROUND

In general, there are three causes of seismic hazards to below-ground lifelines: soil straining induced by seismic ground shaking, ground movement/rupture along fault zones, and soil liquefaction induced by ground shaking.

The major seismic hazards have been observed to come from large ground movement/rupture along fault or soil liquefaction zones. The preliminary responses/failures of below-ground continuous oil and gas lifelines due to ground rupture (Trautmann and O'Rourke, 1983) and fault movements (Kennedy and Kincaid, 1985) have been studied. No specific study devoted to the analysis and design of segmented and jointed water or sewer pipelines for crossing an active fault has been found. Since the effects of fault movement on the transport of water and waste water