

Response of Buried Pipelines Subject to Earthquake Effects

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The earthquake safety of buried pipelines has attracted a great deal of attention in recent years. These pipeline systems are commonly used to transport water, sewage, oil, natural gas and other materials. They are often referred to as "lifelines" since they carry materials essential to the support of life and maintenance of property.

Important characteristics of buried pipelines are that they generally cover large areas and are subject to a variety of geotectonic hazards. They can be damaged either by permanent movements of ground (i.e., PGD) or by transient seismic wave propagation. Permanent ground movements include surface faulting, lateral spreading due to liquefaction, and landsliding. Although PGD hazards are usually limited to small regions within the pipeline network, their potential for damage is very high. On the other hand, wave propagation hazards typically affect the whole pipeline network, but the rate of damage is lower (i.e., lower pipe breaks and leaks per unit length of pipe).

This monograph reviews the behavior of buried pipeline components subject to permanent ground deformation and wave propagation hazards, as well as existing methods to quantify the response. The review focuses on simplified procedures which can be directly used in the seismic analysis and design of buried pipeline components. Where alternate approaches for analysis or design are available, results from the different procedures are compared. Finally, the authors attempt to benchmark the usefulness and relative accuracy of various approaches through comparison with available case histories. Chapters include:

- Review of seismic hazards and the performance of buried pipelines in past earthquakes
- Description of the various forms of permanent ground deformation (PGD) and procedures to quantify and model the amount and spatial extent of PGD
- Review of seismic wave propagation and procedures for estimating ground strain and curvature due to travelling wave effects
- Failure modes and criteria for buried pipelines
- Commonly used techniques to model soil-pipe interaction
- Response of continuous pipelines subject to longitudinal and transverse PGD

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