Seismic and Tsunami Resiliency of Bridge and Transportation Structures

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Abstract

Earthquakes can happen in Washington State at any time, and history indicates there may be substantial shifting of land during a seismic event. The State Department of Transportation's manages approximately 18,500 highway lane miles and more than 3,600 bridges on the state's highway system. One of the agencies objectives is to ensure that state highways will be able to provide emergency responders access to damaged portions of the community quickly to provide Recovery life-saving services. State Highways will also need to provide the capability for the state economy and the movement of freight and goods to be re- stored as quickly as possible.

In an earthquake, damage to infrastructure bridges is more closely related to ground motion rather than magnitude. In addition, the ground type can significantly influence ground acceleration. Base on the geographic area and historical data geologists can create seismic hazard maps which show likely earth-quake ground motion zones. This paper discusses the seismic design requirements for bridges and challenges to achieve these requirements for new and existing bridges.

Keywords: seismic; tsunami; resiliency; performance.

1 Bridge Seismic Resiliency

Seismic design of bridges begins with a global analysis of the response of the structure to earthquake loadings and a detailed evaluation of connections between the superstructure and the supporting substructure. Ductile behavior is desirable under earthquake loadings for both the longitudinal and transverse directions of the bridge. Further, the substructure must be made to either protect the superstructure from force effects due to ground motions through fusing or plastic hinging, or to transmit the inertial forces that act on the bridge to the ground through a continuous load path. Plastic hinging is often considered as a mechanism to form and facilitates transverse and longitudinal movement of bridge bents and frames.

Every bridge shall be designed with an Earthquake Resisting System that ensures a load path for gravity loads and provides sufficient strength and ductility to achieve the specified performance criteria.

The plastic hinge ductility or other means of energy dissipation/bridge damping shall be adequate to satisfy the deformation demands imposed by the "design seismic hazards" while minimizing the probability of bridge collapse.

Earthquake Resisting Systems shall consist of the following:

• Seismic critical members – ductile structural members that are intentionally designed to deform inelastic through several cycles without significant loss of strength, thereby limiting the forces

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