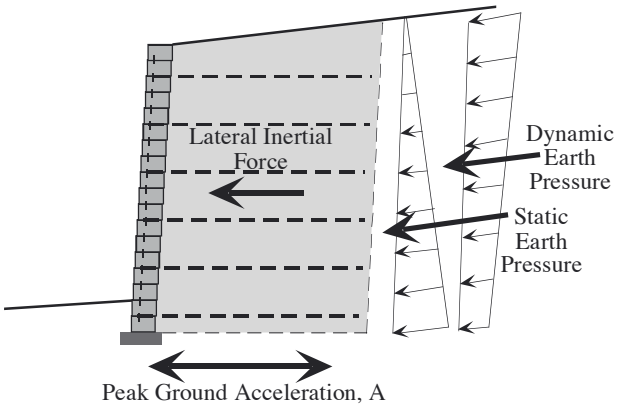
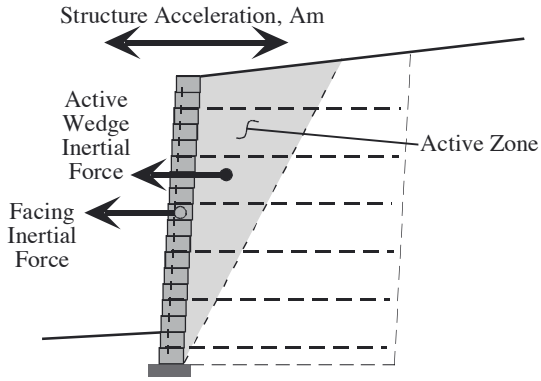
Seismic Design

Keystone retaining wall structures have proven to be earthquake resistant due to the system's inherent flexibility which permits minor yielding during a major seismic event. The lack of observed performance problems with retaining structures after major earthquakes has resulted in little attention being given to improving seismic design methods and codes compared to more sensitive building and bridge structures. Most codes are silent on retaining wall seismic design criteria or methods and the issue is left to owners and engineers on a project by project basis.

The only published seismic design standards are contained in the AASHTO Standard Specifications for Highway Bridges which describe a psuedo-static method of analysis based on the Mononobe-Okabe application of conventional earth pressure theory. A schematic of psuedo-static analysis considerations is shown below as it pertains to soil reinforced structures.



External Stability



Internal Stability

A seismic design must evaluate the combined loading condition of static, dynamic, and inertial forces acting on the structure, both externally and internally, and provide sufficient resistance to mitigate failure during the design event. It is customary to utilize 75% of the normal static design safety factors (ie; 75% of 1.5 min = 1.1 min) for the combined loading condition analysis.

Sliding, overturning, and bearing pressure are analyzed in the conventional manner including the additional driving components of dynamic earth pressure and structure inertial force. Peak bearing pressure and eccentricity can also be checked but there is no particular acceptance criteria for these items. Soil liquefaction can also be a factor in seismic analysis which must be considered as part of the site geotechnical investigation.

Internally, the soil reinforcement strength, connection to the facing system, and soil pullout are checked to insure that rupture or pullout will not occur during the design event. Additionally, local stability of the upper units is checked to insure that the top of wall will not overturn as a small gravity structure.