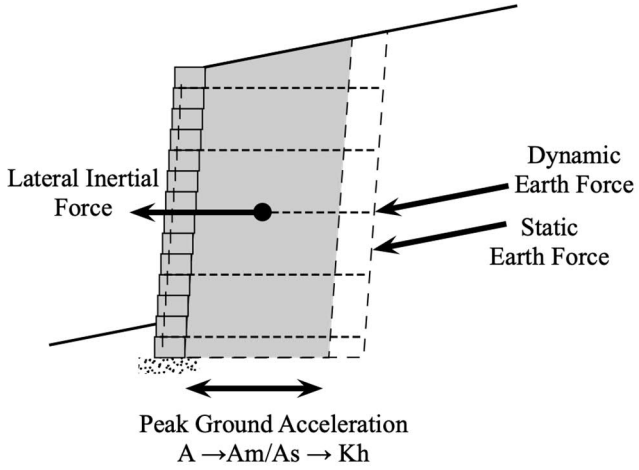
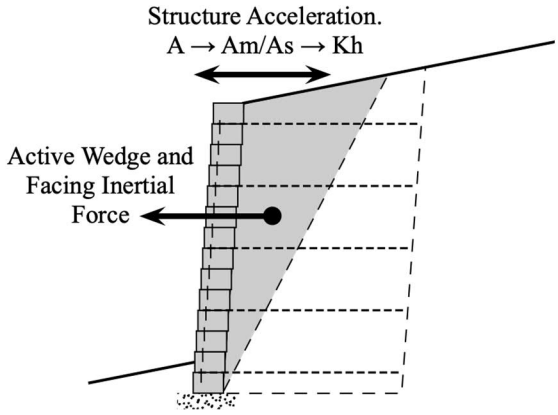
Seismic Analysis

Mechanically stabilized earth (MSE) retaining structures, like Keystone Retaining Walls, have proven to be earthquake resistant due to the system's mass and 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. AASHTO has taken the most aggressive approach in recent years and reduced the design loading for the seismic analysis of retaining structures and even suggesting that seismic analysis may not be required in zones with a A < 0.40g if no other considerations are present.

Most suggested seismic analysis methods describe a psuedo-static method of analysis based on the Mononobe-Okabe application of conventional earth pressure theory. However, the selection of the appropriate Kh value to use in the internal and external analysis based on displacement considerations is still not well understood. A schematic of psuedo-static analysis considerations is shown below as it pertains to soil reinforced structures. The specific calculation of the various load components varies between methods but the concepts are similar.



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. AASHTO LRFD has recently gone to a load factor equal to 1.0 for all external load components yet retaining partial load factors for the internal 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 and slope stability 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.