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SEISMIC RESPONSE ANALYSIS OF A REINFORCED SOIL WALL

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Mechanical Stabilized Earth (MSE) walls are in a period of enormous growth. It is quite reasonable that retaining wall design and construction have occupied a crucial position in the historical development of geotechnical engineering. Retaining walls were among the first soil-related structures to be considered as both critical and permanent insofar as their service life was concerned. These walls usually reinforced by metal strip or geosynthetics although the geosynthetic reinforced walls are the least expensive of all wall categories. Layers of geosynthetics were used as reinforcement. The geosynthetic reinforcement is based on static external and internal stability design. This paper reports the performance of MSE walls in the seismic load condition and this performance has been established by modeling in FLAC software and then comparing the results of modeling with the theoretical calculations. The theoretical calculation derived from the Federal Highway Administration (FHWA) and the modified Rankine method. This is followed by a numeric example showing that the modified Rankine method is the most conservative and the FHWA method is intermediate. This study tries to suggest a design method based on displacement using finite difference numerical modeling in reinforcing soil retaining wall with strips. Results are presented in graphical and tabular form to show the required tensile force and length of geosynthetic reinforcement to maintain the stability of the reinforced soil wall under seismic conditions. With an increase of seismic accelerations in both the horizontal and vertical directions the stability of the reinforced soil wall decreases significantly, and thus greater strength and length of the geosynthetic reinforcement are required to maintain the stability of the wall. The seismic vertical acceleration in an upward direction gives higher values of the required geosynthetic tensile strength, and the seismic vertical acceleration in the downward direction yields higher values of the length of geosynthetic reinforcement. Numerical results illustrate that the seismic response of this type of wall is highly dependent to cumulative absolute velocity, maximum acceleration, and height and reinforcement length so that the reinforcement length can be introduced as the main factor in the shape of failure.

Table 1. Model specifications.

Soil Unit	Unit Weight (pcf)	Friction Angle (Degrees)	Cohesion (psf)	Dilation Angle (Degrees)	Young's Modulus (psf) [a]	Poisson's Ratio
1 - embankment fill	135	35	10	5	$3.1e4 * \sigma'_m{}^{1/2} \geq 8.9e5$	0.35
2 - reinforced fill	140	37	10	7	$3.1e4 * \sigma'_m{}^{1/2} \geq 8.9e5$	0.35

Table 2. Reinforcing Element Properties.

Properties	Scaled FLAC Input per Strip[a]
Area	a = 0.00206 ft^2
Perimeter	p = 0.0693 ft/ft
Elastic Modulus Yield Strength	e = 8.49e8 psf yield = 3915 lb/ft
Compressive Strength Soil/Reinforcement Adhesion Soil/Reinforcement Friction	ycom = 3915 lb/ft sbond = 0 psf sfric = 37°
Soil/Reinforcement Stiffness	kbond = 1e6 psf/ft

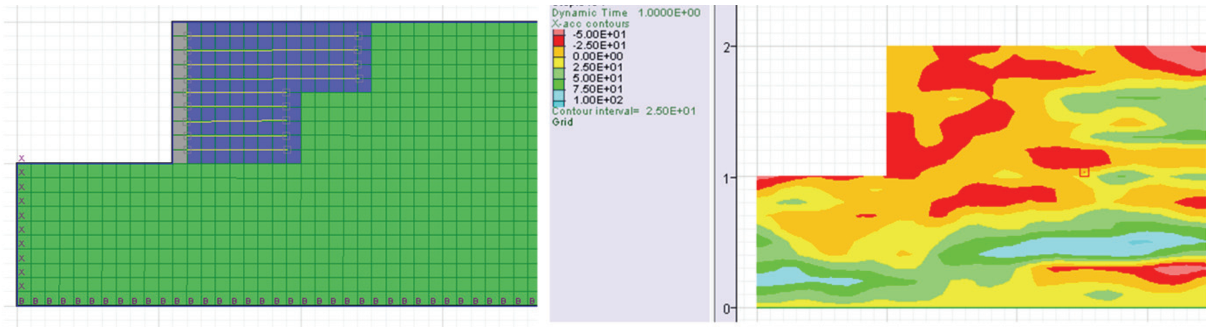

Figure 1. Geometry of reinforced soil wall model (left) and horizontal acceleration response (right).

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