COMPARATIVE STUDY OF SEISMIC BEHAVIOUR OF DIFFERENT KINDS OF CANTILEVER RETAINING WALL

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Design of cantilever retaining wall needs both the geotechnical and structural considerations. It includes the complete study of earth pressure distribution and its point of application, displacement, bending moment and shear force on the wall when subjected to different kind of loading. The objective of this study is to analyze and compare the results of a cantilever retaining wall with standard dimensions subjected to static and pseudo-dynamic loading.

Also, the performance of inclined and vertical retaining walls as well as the foundation wall displacement from bottom to out of the embankment is investigated in dynamic state (Figures 1 and 2).

Figure 1. Typical Arrangements of Reinforced Concrete Cantilever Retaining Walls

Figure 2. Inclined and Vertical retaining walls

In this study plain strain numerical analysis is performed using Plaxis dynamic program. The studied soil is chosen dense granular sand and modeled as elasto-plastic material according to Mohr–Coulomb criteria while the gravity wall is assumed elastic Structural damage and serviceability criteria adopted in existing codes and guidelines are illustrated. A series of results of numerical analyses conducted with a FE code and the influence of some parameters on the results of dynamic analysis are discussed.

By comparing the resulted seismic wall displacements calculated by numerical analysis for six historical ground motions with that calculated by the pseudo-static method, it is found that numerical seismic displacements are either equal to or greater than corresponding pseudo-static values.

Limit-state analysis method based on Pseudo-static approach is among several methods that have been used to study seismic stability of gravity retaining walls (Mononobe and Matuo (1929), Okabe (1924) and Choudhury et al (2002)). The permissible horizontal displacement according to Eurocode (1994) equals 300.amax (mm), while according to AASHTO (2002) it equals 250.amax (mm), where amax is the maximum horizontal design acceleration.

Table 1. Dynamic property of different historical (Ibrahim, 2014)

No.	Earthquake	amax (m/s2)	Vmax (m/s)	dmax (m)	t(s)	ffund (c.p.s.)	Date
1	El-Centro/Imperial Valley	3.36	0.35	0.091	80	1.5	1940
2	Shake	3.69	0.51	0.144	30	0.5/1.4	1906
3	Taft Lincoln School Tunnel/Kern County	1.81	0.17	0.062	70	0.6/1.0/2.2	1952
4	Topanga Canyon Fire Station/Northridge	3.22	0.15	0.039	40	0.6/1.8/4	1994
5	Treasure Island/Loma Prieta	1.54	0.332	0.12	20	0.5/1.8	1989
6	Yerba Island/Loma Prieta	0.634	0.146	0.046	30	0.8/1.8	1989

Table 1 shows the maximum ground accelerations, maximum relative velocities, maximum ground displacements, earthquake violent duration, fundamental frequency (f_f) and date of occurrence for six historical earthquakes.

The deformed mesh for static analysis is shown in Figure 3. The deformed mesh for the different sample rates for pseudo-dynamic analysis is shown in Figure 4.

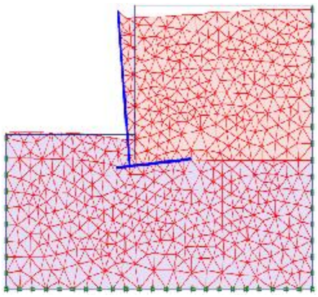

Figure 3. Deformed mesh for static analysis

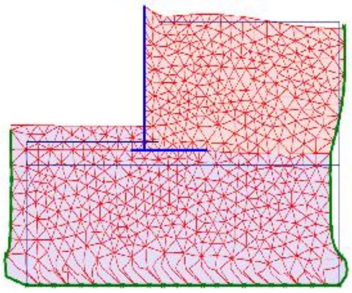

Figure 4. Deformed mesh for dynamic analysis

Comparisons of several cases including vertical and inclined walls based on internal and external design criteria indicate that the inclined retaining walls act more properly than others from technical, practical, and economic viewpoints.

It is also found that seismic wall displacement is directly proportional with the positive angle of inclination of the wall, soil flexibility and with the earthquake maximum ground acceleration.

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