World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:15, No:05, 2021

Influence of Surface Fault Rupture on Dynamic Behavior of Cantilever Retaining Wall: A Numerical Study

Authors : Partha Sarathi Nayek, Abhiparna Dasgupta, Maheshreddy Gade

Abstract : Earth retaining structure plays a vital role in stabilizing unstable road cuts and slopes in the mountainous region. The retaining structures located in seismically active regions like the Himalayas may experience moderate to severe earthquakes. An earthquake produces two kinds of ground motion: permanent quasi-static displacement (fault rapture) on the fault rupture plane and transient vibration, traveling a long distance. There has been extensive research work to understand the dynamic behavior of retaining structures subjected to transient ground motions. However, understanding the effect caused by fault rapture phenomena on retaining structures is limited. The presence of shallow crustal active faults and natural slopes in the Himalayan region further highlights the need to study the response of retaining structures subjected to fault rupture phenomena. In this paper, an attempt has been made to understand the dynamic response of the cantilever retaining wall subjected to surface fault rupture. For this purpose, a 2D finite element model consists of a retaining wall, backfill and foundation have been developed using Abaqus 6.14 software. The backfill and foundation material are modeled as per the Mohr-Coulomb failure criterion, and the wall is modeled as linear elastic. In this present study, the interaction between backfill and wall is modeled as 'surface-surface contact.' The entire simulation process is divided into three steps, i.e., the initial step, gravity load step, fault rupture step. The interaction property between wall and soil and fixed boundary condition to all the boundary elements are applied in the initial step. In the next step, gravity load is applied, and the boundary elements are allowed to move in the vertical direction to incorporate the settlement of soil due to the gravity load. In the final step, surface fault rupture has been applied to the wall-backfill system. For this purpose, the foundation is divided into two blocks, namely, the hanging wall block and the footwall block. A finite fault rupture displacement is applied to the hanging wall part while the footwall bottom boundary is kept as fixed. Initially, a numerical analysis is performed considering the reverse fault mechanism with a dip angle of 45°. The simulated result is presented in terms of contour maps of permanent displacements of the wall-backfill system. These maps highlighted that surface fault rupture can induce permanent displacement in both horizontal and vertical directions, which can significantly influence the dynamic behavior of the wall-backfill system. Further, the influence of fault mechanism, dip angle, and surface fault rupture position is also investigated in this work.

Keywords : surface fault rupture, retaining wall, dynamic response, finite element analysis
Conference Title : ICEGEA 2021 : International Conference on Earthquake Geotechnical Engineering and Applications
Conference Location : Sydney, Australia
Conference Dates : May 17-18, 2021