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Seismic Active Earth Pressure on Retaining Walls with Reinforced Backfill

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Abstract : The increase in active earth pressure during the event of an earthquake results sliding, overturning and tilting of earth retaining structures. In order to improve upon the stability of structures, the soil mass is often reinforced with various types of reinforcements such as metal strips, geotextiles, and geogrids etc. The stresses generated in the soil mass are transferred to the reinforcements through the interface friction between the earth and the reinforcement, which in turn reduces the lateral earth pressure on the retaining walls. Hence, the evaluation of earth pressure in the presence of seismic forces with an inclusion of reinforcements is important for the design retaining walls in the seismically active zones. In the present analysis, the effect of reinforcing horizontal layers of reinforcements in the form of sheets (Geotextiles and Geogrids) in sand used as backfill, on reducing the active earth pressure due to earthquake body forces has been studied. For carrying out the analysis, pseudo-static approach has been adopted by employing upper bound theorem of limit analysis in combination with finite elements and linear optimization. The computations have been performed with and out reinforcements for different internal friction angle of sand varying from 30 ° to 45 °. The effectiveness of the reinforcement in reducing the active earth pressure on the retaining walls is examined in terms of active earth pressure coefficient for presenting the solutions in a non-dimensional form. The active earth pressure coefficient is expressed as functions of internal friction angle of sand, interface friction angle between sand and reinforcement, soil-wall interface roughness conditions, and coefficient of horizontal seismic acceleration. It has been found that (i) there always exists a certain optimum depth of the reinforcement layers corresponding to which the value of active earth pressure coefficient becomes always the minimum, and (ii) the active earth pressure coefficient decreases significantly with an increase in length of reinforcements only up to a certain length beyond which a further increase in length hardly causes any reduction in the values active earth pressure. The optimum depth of the reinforcement layers and the required length of reinforcements corresponding to the optimum depth of reinforcements have been established. The numerical results developed in this analysis are expected to be useful for purpose of design of retaining walls.

Keywords : active, finite elements, limit analysis, presudo-static, reinforcement
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