Impact of Soil-Structure Interaction on Underground Shelters with Pile Foundations and Periphery Walls under Blast Loading

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The rising global threat of war has emphasized the need for underground shelters as vital protection. These shelters have become essential for safeguarding lives in the face of escalating security risks worldwide. In the event of a blast, underground shelters with piles first experience the load on their peripheral walls, supported by the surrounding soil, which then transfers the load to the piles. The optimized pile design can be done by considering the interaction behavior between the soil and the periphery wall. Dynamic response of the underground building with pile foundation and periphery wall during blast loading condition using the finite element analysis done in ABAQUS CAE software was investigated. The structure is modelled using shell elements, wherein the effects of soil-structure interaction are incorporated by modelling the soil using frequency independent spring dashpot mass model. This study focus on the effect of soil structure interaction for the above mentioned building by giving soil conditions with higher and lower stiffness and with blast load of varying duration. The results indicate that, during static condition the force transfer to the piles is lesser when soil stiffness condition is higher as the periphery wall attract more force than piles and vice-versa. During dynamic condition, the same behavior follows with the increased reaction with lesser blast duration and then arrives the static equivalent reaction as the blast duration increases. The findings of the study can be used to optimize the design of pile foundation system along with periphery wall for underground buildings by taking the advantage of the surrounding soil.