

ABSTRACT

During Kolkata metro railway construction in the late 1980s using braced excavation systems, it was observed that the excavation sequence and the rate of excavation including delay during construction had a major impact on the deformation behavior of the excavation system. In order to access the effect of these and other associated factors like excavation depth, excavation width, diaphragm wall thickness, wall embedment depth, strut locations, and soil properties, finite element analysis of typical braced excavations in soft clayey deposits of Kolkata is performed. In the present study, a thorough, parametric study has been conducted using finite element analysis to address the influence of various parameters on deformation characteristics of braced excavation in soft clayey deposits. The importance of correct estimation of soil parameters for braced excavation design is also documented. The analysis of typical braced excavations in soft clay is carried out using Plaxis 2D software where the soft soil creep constitutive model is used. On the basis of numerical study, a handy design guideline is recommended. Further multi-variate regression models are developed incorporating various important excavation parameters for adequate prediction of maximum wall and ground displacement along with wall and ground surface deformation profile. Here large numbers of data reported in case histories and generated artificially from FE analysis are used for formation of regression equations. The proposed model is validated comparing results from literatures not used for development of the model. Further, extensive study has been conducted to understand the effects of excavation rate and construction stoppages on ground and braced wall displacement. Fitted equations are developed for the maximum ground settlement and maximum lateral wall deflection conducting multi-variable regression analysis where time parameters like rate of excavation, pause in construction and depth of excavation are used as independent parameters. Further, a systematic study of the layer wise ground deformation behind a braced excavation in soft clayey soil similar to that available in Kolkata is performed using physical model study using a geotechnical centrifuge for different depths of excavation, number of struts and also considering construction delay or construction stoppage after reaching the final cut level. The mechanism of this deformation was also assessed by evaluating the contribution of undrained, consolidation and creep deformation to the total ground deformation. The tests results were also used to predict the effect of construction delay on various important

factors like rate of settlement, change of zone of influence behind a braced wall etc. The experimental results are also validated with the observed values obtained from reported case studies.

Keywords: Finite element analysis; Braced Excavation; Ground Movement; Wall Deflection; Soft Soil Creep Model; Multi-variate Regression Models; Rate of excavation; Pause Time; Geotechnical Centrifuge; Undrained Deformation; Consolidation Deformation; Creep Deformation.