SIMULATION OF DEEP EXCAVATION USING FINITE ELEMENT METHOD

Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Engineering in Geotechnical Engineering

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Abstract

Finite Element calculations are frequently used in the design of deep excavations because prediction of ground movements and wall deformation is not possible with classical limit equilibrium fixed earth support and free earth support methods. To solve such geotechnical boundary value problems successfully, appropriate constitutive laws should be used for the description of mechanical behaviour of the soils.

Two possible behaviour of soils can be categorized as those with a constitutive law based on plasticity and those based on elasticity. A key distinction between the plasticity and the elasticity group is that in the latter, strains are recoverable upon decrease in stresses, where as in elastoplastic models strain are only partly recoverable.

A crucial point in making the choice of a suitable soil constitutive model is the ease with which values can be assigned to the model constants. The level of investigations carried out and the type of data available is another factor. Considering the above points mentioned, the study summarizes the application of a simple linear elastic model and a non linear elastic [Hyperbolic] model for modeling the 15m deep base excavation supported by an anchored secant bored pile wall.

Finite element software SIGMAW is applied for a 2-D plain strain type analysis. The mechanical behaviour of the soil is modeled with linear and non linear elastic constitutive model using reasonable soil parameters, derived through limited tests.

The actual excavation was carried out in 4 steps. Pre-stressed anchors were used as additional supports, just before each excavation step. The wall deformations were obtained through inclinometers installed at several locations. The FEM simulation was carried out in this research and the computed and observed deformation patterns were compared.

CONTENT

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List of symbols

Ei	Initial Tangent Modulus
K_i	Initial Modulus Number
n	Modulus Exponent
P_a	Atmospheric Pressure
R_f	Failure Ratio
σ_1	Major Principle Stress
σ_3	Minor Principle Stress
ϵ	Axial Strain
C	Cohesion
Ø	Soil Friction Angle
E_{ur}	Unloading-reloading Modulus
K_{ur}	Unloading-reloading Modulus Number
E_t	Tangent Modulus
K_t	Tangent Modulus Number
ν	Poission's Ratio