

Investigation of about the effective parameters on the underground circular tunnel settlement using FEM and PLAXIS software

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Abstract

Tunnels are the famous underground structures . We can use the analytical , experimental and numerical methods to analysis the tunnels . Numerical methods such as FEM , FDM , ... are reliability , fast and are the best , special for the complex boundary conditons . Finite element method (FEM) and PLAXIS software used to parametric research of the effective elements on the tunnel settlemet . Diameter of tunnel , Depth of tunnel (the distance between the tunnel center to the ground surface) , adjacent building loading and distance between the tunnel center to the building , water table , earthquake loading were the effective parameters on the tunnel structural behavior for the both of adhesive and cohesionless soils . Settlement of the tunnel crest was investigated in this article . The results showed the increasing settlement with the tunnel diameter unless for the diameter 4 to 5 meters and reducing the settlement with the tunnel depth unless for the tunnel depth 15 to 20 meters for the undrained adhesive soil and the 6 stories building equivalent surcharge . The results showed reducing settlement with the tunnel diameter up to 4 meters for diameter and then increasing rapidly for the higher diameter values , Also the settlement reducing with the tunnel depth until the depth 15 meters and then increasing with the tunnel depth for the higher values for the cohesionless soil and the 6 stories building equivalent surcharge too .The results showed the linear relationship between the crest settlement and the building surcharge . The results showed that the crest settlement increases with the distance (between tunnel center and building center) until about 50 meters and then constant . For two horizontal tunnel dugout , the settlement reduces up to 40 meters for the center to center distance and then increases , but this settlement relationship to the soil and tunnel properties .



Keywords : Underground structure , Analytical , Experimental , Numerical , Reliability , Adhesive soil , Cohesionless soil .

1.Introduction

There are variety methods to analysis the geotechnical engineering problems such as analytical , experimental and the numerical . Tunnel is one of the famous and important underground structures . Stability analysis of the tunnels is the art and can do perform by analytical , numerical method or both of them .We must care about the tunnel construction in the urban areas . Water level variation , building surcharge loading , tunnel geometry characteristics and location of tunnel and the other parameters are must be consideration for tunnel stability analysis . FEM or FDM (or both of them) can use to analysis of these problems . These methods (FEM , FDM , ...) are fast and reliability and we able to analysis the problems with the complex boundary conditions (with the complex loading conditions or the boundaries or both of them) . Finite element method (FEM) and PLAXIS software used for the parametric analysis of the bored tunnel and consequence of it on the earth settlement for the adhesive and cohesionless soils in this article . The influence of the tunnel depth and diameter and the distance of the tunnel center from the buiding location on the soil settlement were the topics that investigated in this article . Tunnel lining may be used for the stability of tunnel for the loose (or soft) soils (or the weak rocks) . We want to know about the tunnel diameter influence on the tunnel crest settlement if the structure surcharge loading exist . Also we want to know the tunnel depth (distance from ground surface to tunnel center) influence on the tunnel crest settlement if the structure loading exist and we want to know about the tunnel horizontal distance (tunnel center distance to the buildig) influence on the tunnel crest settlement . The model of tunnel assumed that the plane strain and soil assumed as MC model . The boundary extended about 5 to 10 times of the tunnel diameter . Surcharge loading assumed about 60 KN/m² (6 stories building surcharge equivalent loading) to settlement analysis . Stage construction used to simulation of the real conditions for the surcharge loading , tunnel excavation and tunnel contraction (for the undrained soil and the effect of dewatering on the tunnel) .

2.Influence of tunnel diameter and tunnel depth on the tunnel crest settlement