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Tunnel Analysis using Plaxis 2D

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***Abstract*: Worldwide, last nineteenth century the number of people living in urban areas increased day by day. The designers are turning to underground applications for additional infrastructure. The construction of subway tunnel for different utilities will definitely induce some amount of ground surface subsidence. The surface settlement during the tunneling and optimum tunnel depth could be based on the analytical, empirical or numerical methods. Present work was aimed to evaluate the location of tunnel depth and effect of existing structure on tunnel by observing the deformation of soil mass while tunneling. Hence to avoid such ground subsidence and effect of this on surrounding areas many methods are used to determine stresses induced due to such subsidence/settlement. In this study we choose the software plaxis 2d to analyze the stresses due to subsidence on tunnel.**

***Keywords*: settlement, plaxis 2d, Finite element method, subsidence.**

1. Introduction

Now a days the number of people living in urban areas increased. The lack of available space and high cost in urban space has significantly increased the demand for tunnels in big urban cities. Planning, designing and infrastructure development in urban areas is the basic need for the growing nations like India. The designers are turning to underground applications for additional infrastructure. Because structures are often built beside or under culturally, commercially or government important structures. Therefore, it necessitates adopting and developing the innovative and new technologies for faster growth of construction. India has long coastal region having complex deep seated soft clay extended to a depth of 10m to 30m. Today, there are more than subway tunneling operating for urban utilities.

The surface settlement during the tunneling and optimum tunnel depth could be based on the analytical, empirical or numerical methods. Present work was aimed to evaluate effect of existing structure on tunnel by observing the deformation of soil mass while tunneling. Unprecedented and uncontrollable growth of the cities, scarcity and exorbitant price of land, failure of long-term planning are some of the man made circumstances which compel the city authorities to look for the required space deep underground to accommodate the basic infrastructure needs of the growing population. Public transport, water supply, sewerage disposal are some of the services where tunneling can be effectively used. Use of tunneling for transport gives an added advantage in respect of the control over noise and air pollution in cities. The site investigation should be performed to find out the physical and mechanical properties of the ground and existence of underground water, as well as deformation characteristics, especially the stiffness. Therefore, it is required to studied the ground surface settlement, Location of tunnel, geometry of tunnel, effect of existing structure on tunnel, effect of pile on tunnel and earthquake simulation on tunnel.

A. Introduction to plaxis 2d

The development of PLAXIS began in 1987 at Delft University of Technology. The initial purpose was to develop an easy-to-use 2D finite element code for the analysis of river embankments on the soft soils of the lowlands of Holland. In subsequent years, PLAXIS was extended to cover most other areas of geotechnical engineering. Because of continuously growing activities, the PLAXIS company (PLAXIS bv) was formed in 1993. In 1998, the first PLAXIS 2D deformation and stress analysis program for Windows was released. Software is based on the finite element method and intended for 2-Dimensional and 3Dimensional geotechnical analysis of deformation and stability of soil structures, as well as groundwater and heat flow, in geo-engineering applications such as excavation, foundations, embankments and tunnels.

Table 1
Input parameters

Identification	Soft clay	Stiff clay	Clayee sand	Dense sand
Drainage type	drained	drained	drained	drained
γ unsat KN/m^3	16.00	18.20	19.00	19.50
γ sat KN/m^3	18.00	19.50	21.00	21.05
e int	0.500	0.500	0.500	0.500
Kx m/day	0.000	0.001	0.300	1.000
Ky m/day	0.000	0.001	0.300	1.00
E KN/m^3	6250	47900	72000	72000
G KN/m^3	2349.624	18007.519	27692.308	27692.308
E oed KN/m^3	9260.283	70970.80	96923.077	96923.077
C ref KN/m^3	5.00	5.00	2.00	1.00
Φ	23	26	36	36
Ψ	0	0	0	1.00
Einc KN/m^2/m	0	0	0	0
Yref	0	0	0	0
Cinc KN/m^2/m	0	0	0	0
R inter	0.7	0.7	1.0	1.0

Table 2
Input parameter for lining material

Identification	Unit	Lining
Material type		Elastic
EA1	KN/m	1.4E7
EA2	KN/m	1.4E7
EI	KN m^2/m	1.43E5
W	KN m^2/m	8.40
v (nu)		0.1500

2. Methodology

A. Mesh generation

It is expected that stress concentrations occurs around the tunnel, therefore the mesh is refined in those areas. The default global coarseness parameter (medium) is adopted. The generated mesh is displayed in the output program is shown in fig. 1

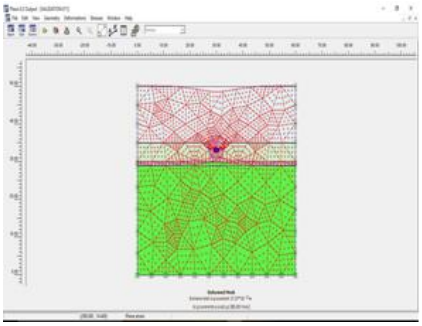

Fig. 1. Finite element mesh for tunnel

Using the above input parameter, the initial phase (without clay bed) is modeled and analyzed using PLAXIS and corresponding total displacement is found to be 0.02903m.

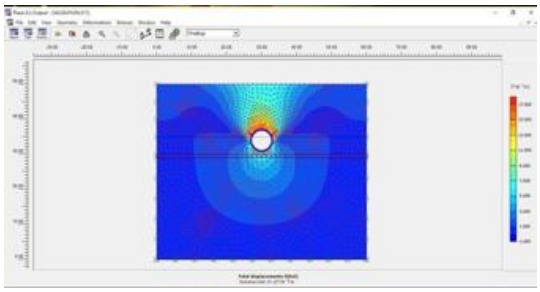

Fig. 2. Total displacement

3. Conclusion

The surface settlement during the tunneling and optimum tunnel depth could be based on the analytical, empirical or numerical methods. Present work was aimed to evaluate effect of surrounding soil on tunnel by observing the deformation of soil mass while tunneling. From the above study in the process of completion of this work the conclusion obtain are as follows, for analyze the effects on tunnel, the software plaxis 2d is used. For validation we take previous research paper and compare its values with our validation. The values of our validation are varies within 1015% of the previous research papers. Hence the software is valid for the analysis of the tunnel. Hence the software can used for further analysis of the effects of surrounding soil and structures on the tunnel.

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