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Improving Ground geomechanical characteristic for Ground movement control in urban zone

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ABSTRACT

Tunneling operation Analyses in 3D conditions is a widely used method to calculate tunneling induced settlement profiles as well as soil structure interactions. The potential of damage, for the surface and/or underground structures can be estimated using powerful finite difference method (FDM). However, setting up a realistic model that would be able to achieve this goal is rather difficult. In this paper, a 3D FDM analysis has been conducted to assess tunneling induced settlement and stress redistribution phenomena along with movements around shallow soft ground tunnels excavation. Displacements recorded during construction of the Line 1 subway Tunnel in Tehran formation were compared with the predicted values to validate numerical estimations. Back analysis carried out on FDM results of soil zone, the data groups that have best accordance with recorded measurements were selected. The results show that grouting has significant effect on tunnel stability and back analysis results have accordance with soil geotechnical properties and grouted zone. Soil strength parameters improved several times and soil permeability decrease significantly. Surveying groutability showed that an increasing in grouting pressure, makes grouting possible in this zone.

Keywords
grouting, FDM, settlement, back-analysis, grout ability

1. INTRODUCTION

The three approaches for limiting the surface settlement which are too important in conventional soft ground tunneling techniques are [21];

1) Improving the ground condition ahead of the advancing tunnel face with ground modification techniques,
2) Reinforcing the tunnel face with soil nails, and
3) Providing a protective vault over the tunnel face.

Permeation grouting consists of injecting a fluid grout under moderate fluid pressures within the voids of the initial soil, and the progressive solidification of the grout will confer improved mechanical or hydraulic characteristics to the treated medium. Grouting, by altering the pore structure, exerts a significant influence over the mechanical and hydraulic properties of the treated medium, in a way similar to cementation. Indeed, both grouted and cemented soils pertain to the family of structured soils, which signifies that their mechanical behavior is governed by the structuring effect created by the cementation between the grains, and implies that the observations made on cemented sands can reasonably be extrapolated to injected soils [14].

In recent years, grouting has been applied successfully in many major tunneling projects to limit ground settlement [15]. For example, during tunnel construction projects in Lisbon and for the underground construction of the Jubilee Line Extension Project in London, extensive compensation grouting systems were applied to protect the surface structure around the area influenced by tunneling construction activities [16, 17].