

## Application of Artificial Ground-Freezing to Construct a Passenger Interchange Tunnel for the Subway Line 14 in Paris, France

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**Abstract :** Artificial ground freezing (AGF) technique is a well-proven soil improvement approach used worldwide to construct shafts, tunnels and many other civil structures in difficult subsoil or ambient conditions. As part of the extension of Line 14 of the Paris subway, a passenger interchange tunnel between the new station at Porte de Clignancourt and the new Tribunal de Grande Instance has been successfully constructed using this technique. The paper presents the successful application of AGF by Liquid Nitrogen and Brine implemented to provide structural stability and groundwater cut-off around the passenger interchange tunnel. The working conditions were considered to be rather challenging, due to the proximity of a hundred-year-old existing service tunnel of the Line 13, and subsoil conditions on site. Laboratory tests were carried out to determine the relevant soil parameters for hydro-thermal-mechanical aspects and to implement numerical analyses. Monitoring data were used in order to check and control the development and the efficiency of the freezing process as well as to back analyze the parameters assumed for the design, both during the freezing and thawing phases.

**Keywords :** artificial ground freezing, brine method, case history, liquid nitrogen

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