Post-print: Grouting Reinforcement Practice for Shield Tunnel Receiving End in Water-Rich Silty Fine Sand Strata of the North China Plain

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Abstract

At a subway interval ventilation shaft located in the North China Plain, the stratum at the shield reception end is predominantly composed of silty clay, clayey silt, and fine sand from top to bottom, characterized by a high groundwater level and strong mobility. For safety considerations, the receiving end was reinforced via high-pressure jet grouting; however, horizontal exploration boreholes indicated persistent risks of water and sand inrush. Technical expert evaluation determined that during portal breakthrough, the shield machine cutterhead would be highly susceptible to water and sand inrush through the portal gap. To ensure successful shield machine portal exit (breakthrough), a design for shield idling through the station was implemented. Surface grouting was employed to perform targeted reinforcement treatment of the water-rich fine sand stratum at the interval ventilation shaft reception end, thereby ensuring construction safety. Following this treatment, the shield machine successfully idled through the station without any occurrence of water and sand inrush.

Full Text

Grouting Reinforcement at Shield Tunnel Reception Shaft in Water-Rich Silty Sand Strata of the North China Plain

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Abstract

The reception shaft of a subway ventilation shaft in the North China Plain is situated in strata composed primarily of silty clay, clayey silt, and silty fine

sand from top to bottom, with high groundwater levels and strong fluidity. For safety considerations, the reception shaft was initially reinforced using high-pressure jet grouting; however, horizontal probe holes revealed persistent risks of water and sand inrush. Technical expert assessment indicated that as the shield machine's cutter head breaks through the portal, water and sand inrush would likely occur through the portal gaps. To ensure successful shield machine breakthrough (completion of tunneling) and to facilitate the design of the shield's empty-propulsion through the station, targeted surface grouting was implemented to reinforce the water-rich silty fine sand strata at the reception shaft, thereby ensuring project safety. Following this treatment, the shield machine successfully completed its empty-propulsion through the station without any occurrence of water or sand inrush.

Keywords: metro shield tunneling; reception shaft; sleeve-valve pipe grouting; GX modified silicone grout; strengthening and reinforcement; water-rich silty fine sand stratum

Note: Figure translations are in progress. See original paper for figures.