

The impossible becomes possible - an infrastructure project

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Summary

To counteract the high volume of traffic in the historical city of Karlsruhe, Germany, the rail infrastructure of the above-ground tracks is being moved underground while maintaining full pedestrian, road and tram operation.

To this end, seven underground stations will be built in the cut-and-cover / dig-and-cast design, and subsequently connected by a tunnel boring machine (TBM) before excavation. After the preparation of the tunnel, the underground stations shall be excavated via the newly established tunnel tube. The concrete construction of the stations will then be a waterproof construction.

The challenge of this downtown project is designing the construction for the handling of the historical buildings in relation to settling and in the construction logistics, involving the step-by-step manufacture of the covers while keeping the traffic above ground running.

Keywords: cut-and-cover design, diaphragm walls, glass-fiber-reinforced plastic (GRP), jet grout bottom, support slab, micro-piles, special foundations, TBM (tunneling machine), water-tight constructions, waterproof construction

1. Introduction

Karlsruhe is the third largest city in the state of Baden-Wuerttemberg, Germany, with approximately 300,000 inhabitants. To the west, the city is framed by the river Rhine, resulting in a water table that is strongly dependent on the water levels of the river. The planned baroque city Karlsruhe dates from 1715 with roads emanating like sunrays from the castle and initially developed solely in a southerly direction. Because of the resulting fan-shaped layout, Karlsruhe has been nicknamed Fan City.

To point the high volume of traffic in the historic city center - passenger numbers of KVV (Karlsruher Verkehrsverbund - Karlsruhe Transport Association) rose from 55 million passengers per year in the mid-1980s to approx. 100 million passengers in 2003 - the rail infrastructure of the above-ground tram lines, which essentially operate along the same routes as 100 years ago, are to be relocated underground.

For this purpose, in a first phase, seven underground stations shall be built, which will then be connected using a tunnel boring machine (TBM) with a slurry supported working face of the route before excavation. While maintaining the aboveground traffic, the stops are built in sections using the cut-and-cover method. Due to the high Rhine-dependent groundwater levels, tangential bored piles or reinforced concrete diaphragm walls are to be used as retaining walls. A grouted sealing blanket made using jet grouting processes shall be used as horizontal blanket.

The construction pit walls are being kept monolithically horizontal with the cover plate of reinforced concrete of the stops (frame corner formation) and at the bottom end by the jet grout bottom, to allow for a limitation of the deformations in relation to the settlement of the immediately