Use of Fibre Reinforced Polymer (FRP) Reinforcement Constructing Diaphragm Pit Walls

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Summary

FRP is an anisotropic composite material with a high tensile strength in axial direction and a high resistance against corrosion. The anisotropy of the material is quite advantageous at excavation pits for the starting and finishing processes at automated excavation like tunnel boring machine (TBM) and Pipe jacking. Concepts of design and their economical advantages are demonstrated by means of projects. For the first time in Germany the FRP reinforcement has been used at diaphragm pit walls at the construction of the metro line stations "Brandenburger Tor" and the North-South-Line in Cologne. Based on the derived design method the final design of the diaphragm pit walls was carried out and the successful functionality was checked during construction phase.

Keywords: design model, temporary constructions, mechanized tunnelling, pipe jacking, break through of pit walls, new materials.

1. Introduction

The technical developments and progresses in the field of tunnelling, especially concerning mechanized methods increase the areas of application in inner city construction projects. Construction methods for the infrastructure (road, railway and underground tunnels) as well as for the supply and disposal can be realised with underground methods and without damaging the surface. This increases the acceptance of such construction methods with residents and approvals can be obtained more easily.

On the other hand, higher investment costs for tunnelling projects with cut and cover methods can lead to a non-profitability of the project. Therefore our aim is to further develop and optimise tunnelling construction methods with regard to its provability by applying new materials.

In order to apply mechanized tunnelling methods, a partial processing of the surface is necessary. Tunnel boring machines are installed into launch boxes and the machines are recovered after the successful tunnelling in target shafts. Especially with regard to excavation pit layers within groundwater it takes a lot of effort to approach and access the excavation pit. Ensuring the density of the excavation pits is a critical aspect in every construction phase. Furthermore, the tunnel boring machines are installed in greater depths, so deep excavation pits with highly reinforced pit walls are required. Tunnel boring machines of today are not capable of passing through steel reinforced pit walls. Conventionally, appropriate additional methods such as:

- Cut-off walls in front of the excavation pits
- Pressure pots inside the excavation pit or
- Sealing blocks in front of the excavation pit

are necessary to manually recover the reinforcement before the machines can pass through.

The second option is to replace the steel inside the pit walls with a material that takes over the static

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