Innovative TBM traffic tunnels

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Abstract

TBM tunnels, ie. tunnels made with the TBM ("Tunnel Boring Machine") technique are currently the most common in the construction of traffic infrastructure, allowing a significant reduction in costs, environmental impact and construction time. However, TBM traffic tunnels still face important challenges.

In order to overcome these challenges, innovative concepts were recently developed by the author: the TISB ("Tunnel of Improved Seismic Behaviour") concept, which allows the reliable construction of TBM tunnels on soft ground in seismic areas, and the TMG ("Tunnel Multi Gallery") and the TMF ("Tunnel Multi Floor") concepts, for rail and road tunnels respectively, allow to obtain very economical tunnels, while significantly improving safety of users during operation.

In the paper the description and justification of these new concepts are presented, as well as their application to TBM railway and road tunnels.

Keywords: Tunnels; TBM; TISB; TMG; TMF; Safety; Earthquakes; Railways;Roadways.

1 Introduction

Tunnels are increasingly used in the construction of traffic infrastructure for both rail and road networks. The TBM ("Tunnel Boring Machine") technique is nowadays the most common, allowing for significant savings in costs and time of construction. It is usual nowadays TBMs build more than 150 meters of tunnel per week in soil and of more than 200 meters in rock.

In the construction of TBM tunnels, the rotating cutting head in front of the machine excavates the ground, while (in shielded machines) the erector mounts precast segments around the excavated surface, forming the circular wall (lining) of the tunnel (figure 1).

Figure 1. Schematic view of a TBM

TBMs are of different types, according to the characteristics of the ground to be bored: Open-Face (Gripper) TBMs for hard rock, Single Shield and Double shield TBMs for fractured rock, EPB and Mixshield TBMs for soils, etc.

Precast segments are made of high strength concrete (C45, or higher), with steel reinforcement or mixed with fibbers. Its number will be the adequate to form complete circles with pieces with a specific weight; commonly medium size tunnels have 6-8 segments per circle.

The thickness of the precast segments depend on the surrounding acting stresses and on the thrust forces applied by the TBM. In common situations it corresponds to about 1/25 of the inner diameter of the tunnel.

2 Challenges

Despite great progress observed in recent times, the construction of traffic tunnels with the TBM technique still faces significant challenges.

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