



Tunnels Supported on Bearing Blocks

S. Pompeu Santos
Civil Engineer
Lisbon, Portugal
pompeu.santos@lnec.pt



S. Pompeu Santos, born 1950, received his civil engineering degree from the Technical Univ. of Lisbon in 1974. In 1983 he obtained his PhD degree at LNEC. His main fields of interest are: Concrete Structures, Precast Structures, Post-tensioning, Masonry Structures and Rehabilitation of Structures

Summary

The paper presents an innovative and cost-effective solution for the construction of tunnels of the roadway and railway types, executed with tunnel boring machines (TBMs), when the referred tunnels are executed in soft soils (e.g., alluviums), in seismic areas. This solution can also be used for the strengthening of existing tunnels, using the existing tunnel as a formwork for the execution of the interior strengthening. In this paper a description of the solution is presented, as well as its application to a specific case.

Keywords: Tunnels, TBM, Bearings, Earthquakes, Soft soils.

1. Introduction

The execution of tunnels with tunnel boring machines (TBMs) is a solution increasingly used for the construction of infrastructures, namely, for roadway and railway transportation systems.

When executing a tunnel with a TBM, the machine excavates the soil and places precast segments, linking them together, in order to form the walls of the referred tunnel, reducing costs and time.

The conventional TBM solution of tunnel building is appropriate for stiff soils (stiff clay, compacted sand, etc), because the tunnels built this way have their stability assured by the strength of the surrounding soil (the precast segments will only function as finishing), hence they do not need to have significant strength in both the transversal direction and the direction of the tunnel axis.

In the case of soft soils (mud, soft clay, loose sand, etc), the execution of tunnels with a TBM is unreliable because, in the tunnel thus formed, the connections between the precast elements are very weak (it is a kind of “LEGO”); hence the strength of the tunnel is low, so there is the risk of sinking, or collapsing, particularly during an earthquake. The soil treatments, used sometimes to help the seismic behaviour of the structure, besides being very expensive, generally do not assure the required reliability.

2. Execution of tunnels with a tunnel boring machine (TBM)

A tunnel boring machine (TBM) is a complex equipment, spanning, in general, more than 100 meters. The type “earth-pressure balance system” is the most usual (Figures 1, 2 and 3) [1, 2].

The main component of the machine is the front shield, which comprises several parts, such as, the cutter rotating head, the watertight bulkhead, the turning motors, the screw conveyor and the erector for mounting the segments.