

TUNNEL BORING MACHINES IN THE EXTENSION PLAN 2003-2007 OF THE METRO OF MADRID

Mendaña, Felipe, Dr. of Civil Engineer, Madrid, Madrid, fms@spicc.e.telefonica.net

The three EXTENSION PLANS OF THE METRO NETWORK of Madrid were implemented in the periods 1995-1999; 1999-2003 and 2003-2007.

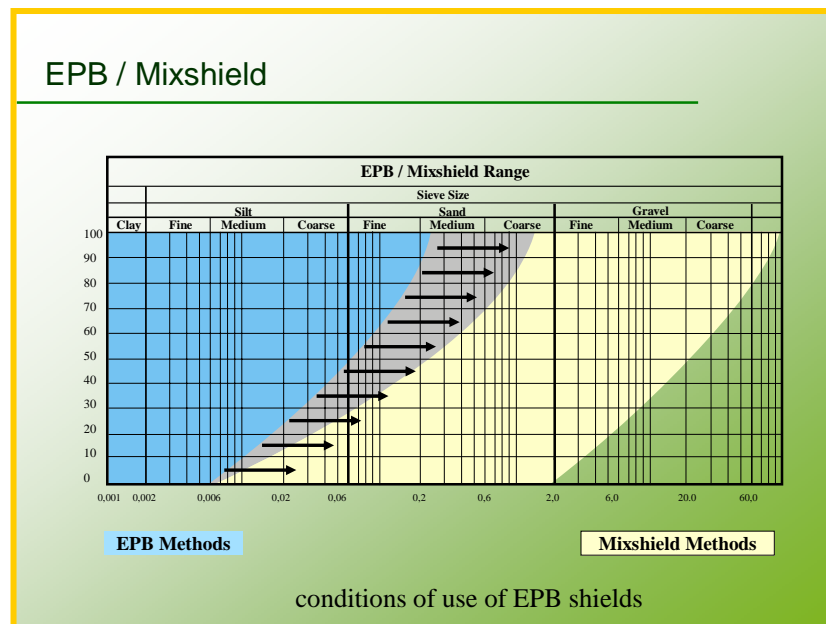
The EXTENSION PLAN 2003-2007, now at an advanced stage, is working with 10 EPB Tunnel machines, some of which have been working on the two prior Plans.

The modern typologies for tunnel excavation in unstable soils are the “hydrosields” or the “EPB shields”. Hydrosields have their field of application well defined, in non –cohesive ground, and the EPB shields were developed to work with cohesive soils.

The EPB shield technology was chosen for the Expansion Plans for the Metro of Madrid because most of the ground in the metropolitan area of the city has those characteristics. Nevertheless it was also necessary to work on stretches with non-cohesive materials as well as to cut layers of rocks in which gypsum was mainly found.

As a consequence, one may state that a wide experience has been obtained in the expansion of the field of EPB shields application, which is of general interest. This experience can be summarised as follows:

1. The graph shows an area shaded on the left which is the field for “EPB” shields and on the right, a clear area, which is the field for hydros: in the middle, marked with arrows, there is the extension zone of the EPB shields we have worked in



2. The experience of the Plans made it recommendable to include a series of modifications in the design of EPB shields. They are.
 - a. Cutting wheel: fixed openings > 30%; special cutters to protect the profiling tools; a certain number of disk cutters to excavate hard materials.
 - b. Mixing chamber: beater bars and high pressure water outlets.
 - c. Activation of the cutting wheel: use of FV electric motors.
 - d. Other improvements: Orientation of the thrust footings and bentonite injection into the chamber.