

ANEJO 4: RESPUESTA CASAS TUNELADORAS



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Tunneling Thesis Information required

1 message

Ignacio SaenzDeSantaMaría-Gatón <ignacio.saenz@gmail.com>

Tue, Jan 30, 2007 at 3:42 PM

To: lovateurope@dial.pipex.com

Dear Miss/Mr,

I'm righting in order to ask for some information which is related to your industry. First of all let me tell you I'm a civil engineering student preparing his thesis in "Costs and Time in tunneling" in the university of Barcelona (UPC). I'd be very grateful if you could help me with the following aspects I had trouble finding information about:

1. Is there an approximate cost (and how accurate would it be) for the tunneling machines (TBM, EBP) which could be found related to some basic parameters such as diameter? Which would it be?
2. How has advance rate and cost grown in the past years?
3. Which is the cost for machine maintenance?
4. Which life expectancy in km can we expect for a machine? Which parameters are there involved?
5. Which is the cost related to assembly?

Thanking you in advance for your assistance,

Ignacio Sáenz de Santa María Gatón.

Dear Ignacio,

We are not tunneling contractors, but in general the cost of tunneling varies a lot by region, country, type of geology, length and diameter of tunnel, requirements for ground support, lining type, whether tunnel starts / ends in a portal or shaft, local labor costs, local work rules, etc. As such, it is very hard to put a price on projects in this industry, as each project is individual and most contractors consider their cost information proprietary. There are some very general guidelines that you could apply to your paper, but again they are not indicative of any one project:

- Cost for a hard Rock TBM with an average list of supporting equipment could be very roughly estimated to be USD 1,900,000 per meter of diameter.
- Cost for an EPB type machine, with an average list of supporting equipment could be very roughly estimated to be USD 1,200,000 per meter of diameter.
- Cost has been flat in real dollars for nearly 15 years until approximately 4 years ago when prices started escalating with the increasing costs of metals and labor in world markets.
- Cost for consumables and spares could be roughly estimated to be USD 10 to 20 per cubic meter of material excavated. This does not include labor costs for maintenance.
- Machines typically must be depreciated 90% during their first project. The machine may be used on many projects / tunnels, however the cost for rebuilding is quite expensive.
- Assembly costs for the TBM vary widely depending again on region, country, labor costs, labor rules, type of machine, size of machine, location of assembly area (on mountain, in city), type of start / assembly (shaft, portal, etc). The assembly cost for a small 3 m TBM might be as little as USD 200,000. The cost of assembly for a very large machine, in a shaft, might be as high as USD 2.5 million.

I hope this helps!

Best Regards,
Desiree Willis

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Dear Ignacio Saenz :

Please find below some comments/data on your enquiry -

1. TBM cost question

In relation to TBM costs, as you pointed out there are definite trends linking them to such basic parameters like the Diameter.

And then, there are some further TBM classification features that affect the TBM cost.

Here are some approximate costs of TBM's for your reference:

0.8 million USD for a TBM 60 inches in diameter

2 -2.5 million USD for a TBM 100 inches in diameter,

3.5-4.5 million USD for a TBM 137 inches in diameter

8-9 million USD for a TBM 238 inches in diameter

Around 17 million USD for a TBM 370 inches in diameter

Around 20 million USD for a TBM 430 inches in diameter

For any particular diameter, the cost would also vary according to TBM features. For example, a TBM could have a combination of one or more of the following features: EPB (Earth Pressure Balance) type equipped with a screw conveyor, P type equipped with Pressure Relieving Gates (PRG's) and unitized belt conveyers, Rock type, Soft-Ground TBM, Slurry type, Segment Erector (SE) type, Pipe Jacking (PJ) type, Gripper Shield (GS) or Double Shield type. Please see our website for more information on our projects that use different types of TBM's.

The use of a Gripper shield (in Rock conditions) drives up the cost. Similarly, a Slurry type TBM will cost significantly higher. A 238 inch Slurry TBM could cost up to 20 million USD. The choice of a Segment Erecting TBM over a Pipe Jacking type would mean higher cost. Having a screw conveyor (EPB type) over having PRG's to control the tunnel face, would mean higher cost.

2. Excavation (advance) rates and cost:

Again, excavation rates and cost would have a relation from the point of view of completion of Tunneling Projects as well as TBM prices. Simply put, faster the excavation lower the overheads, lower personnel costs, less or zero penalties and hence savings in cost. From a TBM point of view, innovation over the years has seen the introduction of technologies such as Ground Conditioning, Segment lining, Double-shielding for continuous excavation, all of which have contributed to higher TBM prices, but ultimately lower project costs brought about by higher excavation rates. In certain locations, weather conditions might permit tunneling only during certain periods of the year, and once again higher excavation rates would become an essential tunneling component.

3. Cost of machine maintenance:

Assuming you are indicating maintenance costs over the duration of a single project, cost of spare parts and consumables for a recent project was around 3 to 4 USD/cubic metres of tunnel. This excluded cutting tool changes/replacements.

4. Life expectancy of machine:

In terms of overall life expectancy, refurbishment (addition of new main drives and other critical parts of the machine) can keep these machines running over multiple projects over many years. Indeed our company's second built machine (from the 1970's) is still in use. During a course of a particular project, life expectancy of individual critical components such as bearings measured in hours (example 10,000hrs @ 5.5 cuttinghead rpm) can be a critical factor.

5. Cost related to assembly:

Assembly costs at the project site, is normally borne by the tunneling contractor (not usually the TBM manufacturer) and the cost will depend on various factors such as: TBM size which will in turn effect the shaft size required to lower, install and assemble the TBM; the depth underground the TBM has to start operating from; cost of personnel; method of assembly.

Please see attached article on Governance of Costs in tunneling. It has an interesting chart of project related cost distribution.

There is also a database covering 630 TBM projects from 1963-1994, assembled at the University of Texas at Austin, USA. It gives the range of conditions and performance achievements by TBMs. You might be able to get hold of this database through your library.

Also please note that we normally do not keep this type of information or release it, so this is all we can provide. Hope it helps and wish you good luck for your Thesis.

Regards,

Anand Dwarkanath

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