

ACS successfully completes excavation of Seattle's tunnel, a milestone in the construction of large-diameter tunnels



Image 1: Moment at which the TBM breaks the exit screen, completing the tunnel.

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ACS Group, through its subsidiary Dragados USA, leads the consortium that has just completed the works of one of the largest tunnels in the world in terms of excavation diameter (17.5m). The tunnel of Seattle, which is nearly 3 km long, runs under the skyscrapers of the urban and business centre of the main North-Western city of the United States, a city where companies such as Microsoft, Amazon or Boeing have their headquarters based.



Image 2: Location of the works and layout of the tunnel, under the city of Seattle.

For the execution of this ambitious project, which was commissioned by the Department of Transportation of Washington and co-financed by the Federal Government, the consortium used a Japanese-made Tunnel Boring Machine (hereinafter, TBM), called "Bertha" in honor of the first female mayor of a big city in the United States. This milestone underpins the long history of Dragados leading the use of large TBMs. At the time of its assembly, in 2013, this TBM was considered the largest diameter TBM ever built, exceeding by 36% the excavation section of the TBMs used for the construction of the M-30 ring road in Madrid in 2005, or surpassing by 112% the ones used in Barcelona 3 years earlier.

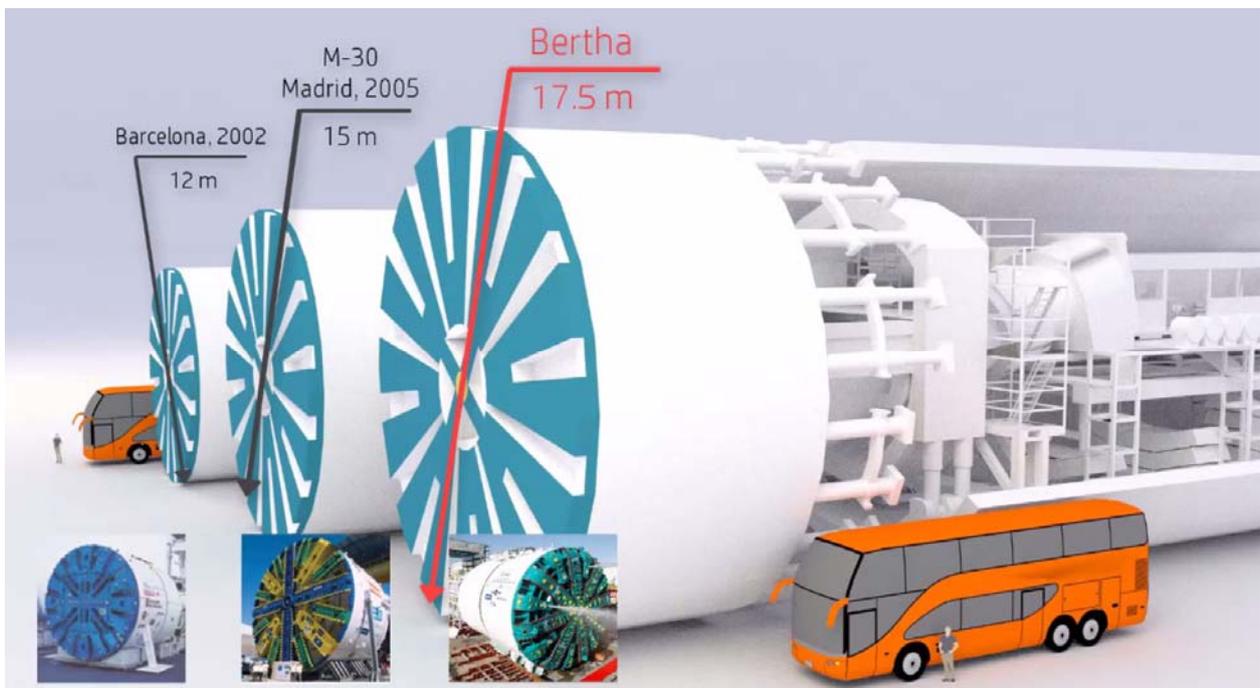


Image 3: Size of Bertha in relation to other TBMs previously used by Dragados, and compared with a bus and a person.

The machine, which is 112 meters long and weighs 7,000 tons, required special means for its transportation by sea from Japan, for its unloading at the port of Seattle and for its assembly on site.



Image 4: Manufacture of the TBM in Japan.



Image 5: Loading of the TBM sections into the ship that carried it from Osaka to Seattle.



Image 6: Assembly of the TBM in Seattle.



Imagen 7: izado y montaje de la cabeza de corte

Once the tunnel is commissioned, it will replace the two-level viaduct that runs parallel to the seafont of Seattle. This tunnel has been built achieving record figures by minimizing surface-induced seats. Dragados Technical Department has actively participated in its control. This, together with its previous experience in the construction of large-diameter urban tunnels have

been the two key points for which the consortium led by Dragados was awarded with the \$1,400 million work.

Having completed the excavation works, efforts will now focus on completing the interior structure, which will support two roadways at different levels, the dismantling of the TBM and the completion of ventilation, fire protection, lighting and control facilities.



Image 8: Execution of the interior structure. In the upper part the ventilation duct can be appreciated, and next to it the convey belt of the excavated material.

ACS Group, through Dragados and its international subsidiaries, is now leading multiple underground works among the most important ones that are in execution today. In addition to Seattle's tunnel and those recently delivered for the new Crossrail line, in London, and Eglinton line, in Toronto, the multinational constructor is now working in projects such as Lima's subway Line 2 (Peru) or the Light Rail System in Ottawa (Canada). Furthermore, the company is in charge of building, in Australia, the tunnels for the North West Rail Link and for the new Westconnex M5 highway, in Sidney.

The company has been recently awarded with the design and construction of a tunnel under Chesapeake Bay in Virginia (USA).

Figures:

- Bertha has a 57-foot-diameter and is 367 feet long. It is as tall as a five-floor building and as long as a soccer field.
- Bertha weighs 7,000 tons. It is as heavy as 450 buses.
- The ten concrete ring segments, which were used to build the lining, were made by a Dragados's Group Company in a plant situated in the region of Seattle. Each of the 1429 full-sized ring segments weighs 170 tons, almost as heavy as a Jumbo 747 plane.
- The ground that is excavated every two meters, in order to place each keystone ring, weighs around 7,000 tons. This excavation product is transported in barges by sea. If it were to be transported by truck, it would be necessary to use fifty of them per ring. The peak reached at fourteen rings in 24 hours, would have meant using 700 trucks, a 20-tons truck every two minutes.
- The maximum seated caused by the excavation has been of 2.5mm, which is equivalent to a 1 euro coin thickness.