



Press Release

HERRENKNECHT

Eight TBM ladies set the pace in London tunnel marathon.

June 19, 2015

London / Schwanau

With the breakthrough of Herrenknecht tunnel borer >> Victoria<<, eight Herrenknecht tunnel boring machines magnificently completed a unique mission at Europe's largest infrastructure construction project on May 26, 2015. In just three years construction crews from three UK and European consortia navigated the high-tech borers from Schwanau through the center of London. Citizens and politicians are proud of the engineering achievements. 42 kilometers of high quality tunnels have been created under one of the world's busiest cities. Crossrail will carry an estimated 200 million passengers per year.

_____ London is actually the cradle of modern tunnelling. Here in 1825 the first successful crossing under a river began using mechanized tunnelling construction. In order to master the soft sandy ground under the Thames the engineer Marc Brunel and his son Isambard Kingdom Brunel designed a special steel frame. In its protection workers dug the tunnel, while right behind them masons reinforced the walls with bricks. This was the birth of shield tunnelling machines. The Thames tunnel took 18 years to complete – an extraordinary pioneering achievement at the time.

The principle of supporting the tunnel face in soft soils and expanding the tunnel in the protection of a shield has remained. Nowadays, however, tunnel boring machines with diameters of up to 19 meters drill through the ground. With modern tunnelling technology pioneer structures of quite a different dimension are created. Right at the forefront in this respect is the Crossrail project in London, a three-year tunnelling marathon that has now successfully completed.

With the breakthrough of the Herrenknecht tunnel boring machine (TBM) named "Victoria" on May 23, London again made tunnelling history. Victoria is the last of eight Herrenknecht TBMs which together have dug 42 kilometers of tunnels right

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through the heart of London. The team of Victoria, Elizabeth, Phyllis, Ada, Jessica, Ellie, Sophia and Mary worked at tremendous speed.

At the official breakthrough celebrations on June 4, UK Prime Minister David Cameron said: "Crossrail is an incredible feat of engineering that will help to improve the lives of working people in London and beyond. The project is a vital part of our long term plan to build a more resilient economy by helping businesses to grow, compete and create jobs right along the supply chain."

Crossrail forms a major new east-west connection through the congested metropolis of eight million inhabitants. Five twin bore tunnels with a total length of 21 kilometers and ten new stations link existing railway networks to the east and west of London. The new railway will stretch from Reading and Heathrow in the west through central London to Shenfield and Abbey Wood in the east.

Andrew Wolstenholme OBE, Crossrail Chief Executive, praised the teams on the completion of the work: "Crossrail is being delivered on time and within budget and will transform how people travel across London. Over the last three years, our highly skilled team have worked tirelessly to build these major new tunnels under one of the world's busiest cities. The challenge now shifts to the complicated and substantial task of fitting out the tunnels and stations to enable Crossrail services to operate."

Machine technology and service from a single source

Project owner Crossrail Ltd (CRL) commissioned three joint ventures with the construction of the five tunnel sections: Bam/Ferrovial/Kier JV with the Western Tunnels, Dragados/SISK JV with the three sections of the Eastern Tunnels and Hochtief /Murphy JV with the Thames Tunnel.

All three joint ventures relied 100 percent on technology from Herrenknecht, the leading provider of holistic solutions in mechanized tunnelling. The company from Schwanau in Baden-Württemberg/Germany supplied six Earth Pressure Balance Shields (EPB) for the construction of the eastern and western tunnels through London clay, sand and gravel. Two Herrenknecht Mixshields excavated the Thames Tunnel at depths of up to 15 meters below the river bed.

At depths of up to 40 meters the tunnel boring machines made their way under some of the most expensive real estate in the world past existing metro lines, sewerage, supply and disposal channels as well as building foundations. The machines with a shield diameter of 7.08 meters are 147 meters long, weigh up to 1,100 tonnes and have a drive power of up to 1,920 kW. For precision targeted control all eight

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machines were equipped with navigation systems from Herrenknecht subsidiary VMT.

Operated by 20 men per shift, twelve men on the TBM, eight on the gantry and above ground, the machines drove 24 hours a day, seven days a week. They achieved impressive advance rates of up to 72 meters (45 segment rings) per day.

Such performances result from perfectly coordinated cooperation between all project participants. "Herrenknecht doesn't just sell a machine and then only leave a phone number. The Herrenknecht people are actually always on site: I have a contact any time I need one," notes Roger Escoda, Tunnel Manager Dragados/SISK Joint Venture.

Herrenknecht supplied the machines together with comprehensive service solutions. These included assistance with the assembly and disassembly of the TBM at the jobsites, the provision of jobsite personnel to support the advance and the supply of cutting tools and spare parts. In addition, together with the customers Herrenknecht developed individual solutions, for example for disassembly in confined shaft conditions, for pulling machines through stations as well as the transport planning for the second use of two TBMs on another section.

"The Crossrail project demonstrates how very good organization and the close cooperation of the individual specialists make it possible to realize projects of this enormous construction logistics complexity within very demanding timelines and binding budget plans with maximum safety," concluded Dr.-Ing. E. h. Martin Herrenknecht, founder and Chairman of the Board of Management of Herrenknecht AG, on the successful completion of the tunnelling.

Crossrail - Europe's largest infrastructure construction site

Crossrail will be a new 118km metro railway from Reading and Heathrow in the west to Shenfield and Abbey Wood in the east via central London. The route connects 40 stations, ten of which are new. The journey time from London Heathrow to the main financial centre in the City of London (Liverpool Street) is shortened from 55 to 32 minutes. 200 million passengers per year are expected.

To deliver Crossrail project up to 10,000 workers are active on more than 40 jobsites. Construction started in 2009, the start-up is scheduled for the end of 2018. The total costs amount to approximately €20.8 billion.

You can get a deeper insight in our jobsite feature
in the second edition of the All Around Online magazine
> <http://allaround.herrenknecht.com/en/issue-2.html>

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MACHINE DATA

Machine type: 6 x EPB, 2 x Mixshield

- › Shield diameter: 7.080 mm
- › Drive power: EPB: 1,600 KW – 1,920 KW / Mixshield: 1,120 kW
- › Torque: EPB: 5,850 kNm – 9,800 kNm / Mixshield: 3,709 kNm
- › Total weight: 850 - 1,100 t
- › Total length: 109 - 147 m

PROJECT DATA

Application: Railway

Tunnel length: 2 x 21,000 m

Geology: Lime/chalk and layers of flint, London Clay (silty to sandy clay with sand and silt and embeddings of calcareous argillite)

Client: Crossrail Ltd (CRL)

Customer: Hochtief - Murphy Joint Venture, Dragados – SISK Joint Venture, Bam - Ferrovial - Kier (BFK) Joint Venture

THE HERRENKNECHT MACHINES IN DETAIL

S-705: EPB Phyllis – Western Tunnel; X Royal Oak to Farringdon west - Bam/Ferrovial/Kier JV

S-706: EPB Ada – Western Tunnel; X Royal Oak to Farringdon west - Bam/Ferrovial/Kier JV

S-719: EPB Elizabeth - Eastern Tunnels; Y Limmo to Farringdon east - Dragados/SISK JV

S-720: EPB Victoria - Eastern Tunnels; Y Limmo to Farringdon east - Dragados/SISK JV

S-721: EPB Jessica - Eastern Tunnels; Z Pudding Mill Lane to Stepney Green - Dragados/SISK JV

S-722: EPB Ellie - Eastern Tunnels; Z Pudding Mill Lane to Stepney Green - Dragados/SISK JV

S-721: EPB Jessica - Eastern Tunnels; G Limmo to Victoria Dock Portal - Dragados/SISK JV

S-722: EPB Ellie - Eastern Tunnels; G Limmo to Victoria Dock Portal - Dragados/SISK JV

S-731: Mixshield Sophia - Thames Tunnel; H Plumstead to North Woolwich - Hochtief /Murphy JV

S-732: Mixshield Mary - Thames Tunnel, H Plumstead to North Woolwich - Hochtief /Murphy JV

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Photos: Eight TBM ladies set the pace in the London tunnel marathon.



Photo 1

After breakthrough of the Herrenknecht tunnel boring machine Victoria, tunnelling on Europe's largest construction site has been completed on May 26, 2015. For a new rail link between west and east, in only three years a total of eight Herrenknecht machines drove 42 kilometers of tunnels through the heart of the City of London.



Photo 2

On May 10, 2015 TBM Elizabeth, the sister machine of Victoria, achieved breakthrough. Together the two EPB Shields have driven the 8.3 kilometer long twin tube from Limmo Peninsula to Farringdon. On their way they went through the Canary Wharf station box, Stepney Green shaft and Whitechapel station.



Photo 3

"Crossrail is an incredible feat of engineering that will help to improve the lives of working people in London and beyond. The project is a vital part of our long term plan to build a more resilient economy by helping businesses to grow, compete and create jobs right along the supply chain," said British Prime Minister David Cameron at the official breakthrough celebrations.



Photo 4

On London's huge Crossrail infrastructure construction site three joint ventures built a total of five tunnel routes in three sections. They all put their faith in the reliability of the machine technology and service from Herrenknecht. The German world market leader in mechanized tunnelling technology supplied all eight tunnel boring machines for the project.

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Photo 5

Tunnel boring machine Victoria being lifted into the Limmo Peninsula launch shaft. From here the tunnel boring machine from Herrenknecht bored its way from east to west through central London. Over a distance of 8.2 kilometers it drove beneath Soho, Hyde Park and some of the most expensive real estate in the world.



Photo 6

The tunnel boring machines S-719 and S-720, later known under the names of Elizabeth and Victoria, at the Herrenknecht plant in Schwanau, Baden-Wurtemberg/Germany. The two machines with a shield diameter of 7.08 meters weigh 1,100 tonnes, are 147 meters long and have a drive power of 1,920 kW.

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For further information: Please contact us.

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Herrenknecht is the only company worldwide to deliver tunnel boring machines for all geologies and in all diameters – ranging from 0.10 to 19 meters. The product range comprises tailor-made machines for traffic, supply and disposal tunnels as well as additional equipment and service packages. Herrenknecht also manufactures drilling rigs for vertical and inclined shafts as well as deep drilling rigs.

In 2014 the Herrenknecht Group achieved total revenue of 1.082 billion euros. The Herrenknecht Group employs around 5,000 people worldwide, including just under 200 trainees (as of March 2015). With 82 domestic and overseas subsidiaries and associated companies working in related fields, Herrenknecht provides comprehensive services close to each project and customer.

› <http://www.herrenknecht.com/en/references>

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