Site report

Long-stroke concrete pumps 5 day non-stop operation

Putzmeister

To improve the supply of drinking water for the 18 million inhabitants of New York, an approximately 100 km (62 mile) long drinking water gallery system is being built at present 165 m (550 ft) below the city. The management of works used 2 long-stroke Putzmeister concrete pumps of the BSA 2110 HD-E series on one section to concrete the tunnel formwork. In addition two large Putzmeister Jumbo concrete mixer troughs have been installed. These served as in-line mixers and "buffer" for the concrete that is supplied batchwise and this makes continuous placing of concrete possible in a 3-shift operation, 5 days a week, "non-stop".

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The concrete is "dropped" through a downward line into the gallery that is 165 m lower down

The gallery system that runs well below the surface is one of the largest and most expensive construction projects in the history of New York. The bill for just the 25.6 km (15.9 mile) long Queens Deep Water Tunnel – the name given to the second of a total of 4 jobs – has been assessed at over 172 million US $. The water supply of the districts of Queens, Brooklyn and Manhattan will be connected up to the new tunnel just after this job section has been completed. This work is being carried out for the New York City Department of Environmental Protection (DEP).

For job section 1, the Brooklyn Deep Water Tunnel, the SheaSchiavone Joint Venture worked on an 8.85 km (5.5 mile) long section in alternate operation with two Putzmeister long-stroke pumps to backfill the tunnel formwork with concrete. The cross-section of the tunnel driven was 5.7 m (18' 11"), the diameter of the inner formwork was 4.8 m (16').

2

Transport wagons (in the rear) pass the concrete to the Jumbo trough for remixing before the BSA 2100 HD-E (in the foreground) takes over the pump conveying

Concrete 165 m in “free fall”

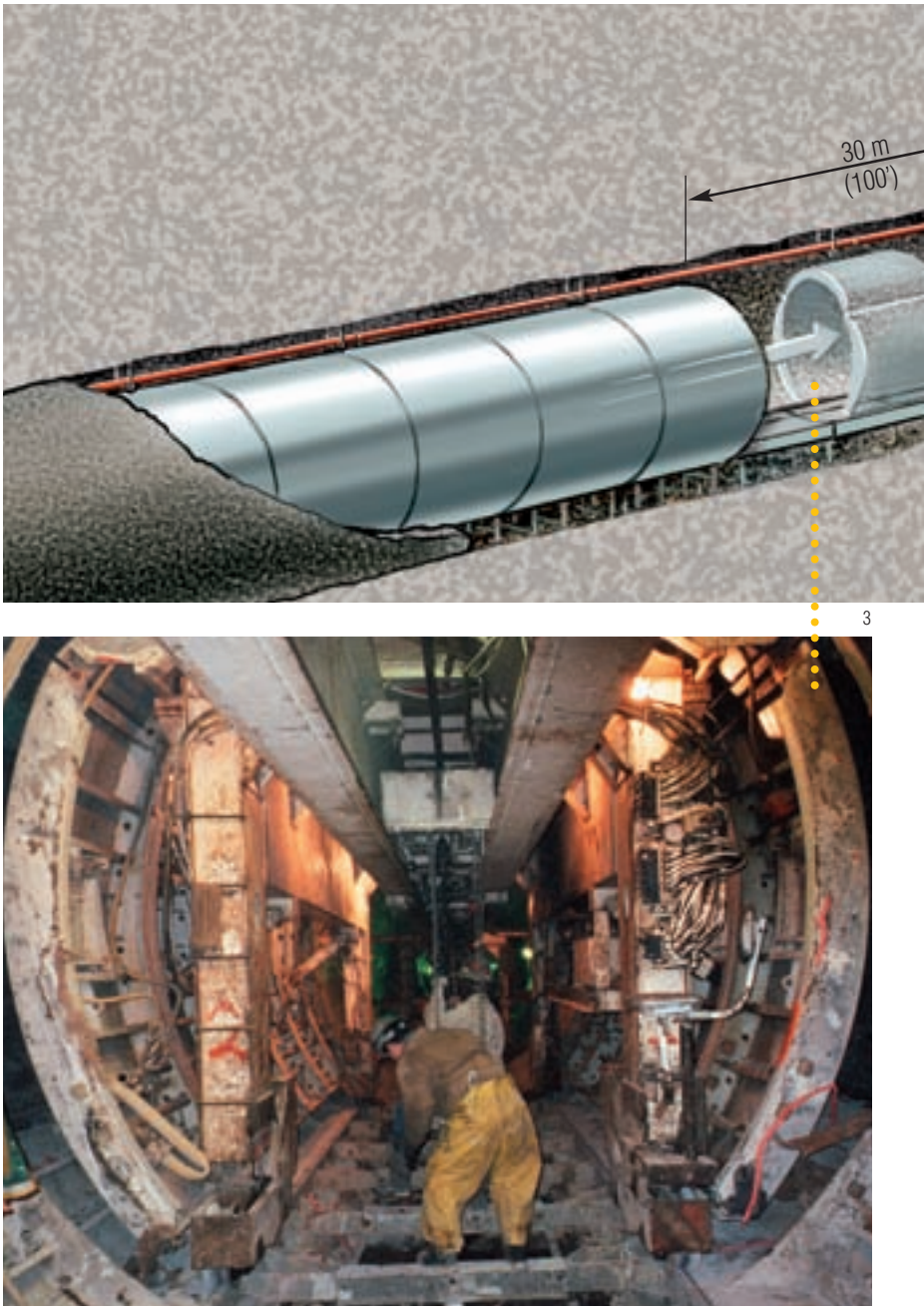
The concrete was supplied by truck-mixers and dumped into the 165 m (550’) deep gallery via a 300 mm (12”) vertical line. At the end of the vertical line was a socalled impact pot (height approx. 1 m, resp. 40”, diameter approximately 0.50 m, respectively 20”) with overflow and which passed over to an inclined line and which filled the transport wagon below with concrete.
The Brooklyn Deep Water Tunnel was formed from the furthest point of the gallery in the direction of the start shaft. Four trains each with two transport wagons were in operation for the transport of the concrete. The trains connected the concrete transfer point (end of the vertical line with impact pot) and the concrete pumps in front of the formwork. The trains both had a transport capacity of 16.7 m^3 (22 cubic yards) of concrete.

Jumbo mixer trough enables continuous concrete placing

About 30 m (100’) in front of the Full Round Formwork was a sledge chassis on rails, onto which a BSA concrete pump along with a 10 m^3 (13 cu. yd) Jumbo mixer trough was mounted. This was charged by the material trains. The Jumbo trough had a double function: on the one hand it worked as remixer of the concrete and on the other hand it was used to guarantee a continuous flow of concrete for the BSA concrete pump for batch supply of concrete. This enabled the management of works to achieve an extremely uniform, interruption-free concreting of the tunnel formwork. In this way an average of 90 m (300’) were achieved per day. The complete unit was pulled by cable winches according to the progress of the formwork. Both Putzmeister concrete pumps BSA 2110 HD-E worked non-stop for a period of four weeks – with the exception of the weekend. Then the second machine took over which had been maintained and serviced meanwhile.

The backfilling of the formwork was carried out on the face of the tunnel form over the top. Here one had connected the pressure outlet of the BSA concrete pumps to a pipeline (diameter 200 mm/8”) which was guided upwards at an angle of 45° into the tunnel roof. Whilst the delivery line lay in the already-formed (shelled) area on the outside of the tunnel formwork facing the ring space, the line was guided by roller bearings outside the formwork. In this way the complete concrete line could be pulled continuously in the tunnel longitudinal direction in free-glidance during the 5-day concrete phase. This type of delivery line guidance (“slick line”) has by the way proven to be very practical as it enables extremely uniform concrete placing.

With increasing construction progress and after the concrete has successfully hardened, the formwork sections were moved continuously in the direction of the start shaft. The whole formwork was then accordingly long – approx. 135 m (450’).



The formwork segments are continuously moved in the direction of the shaft start

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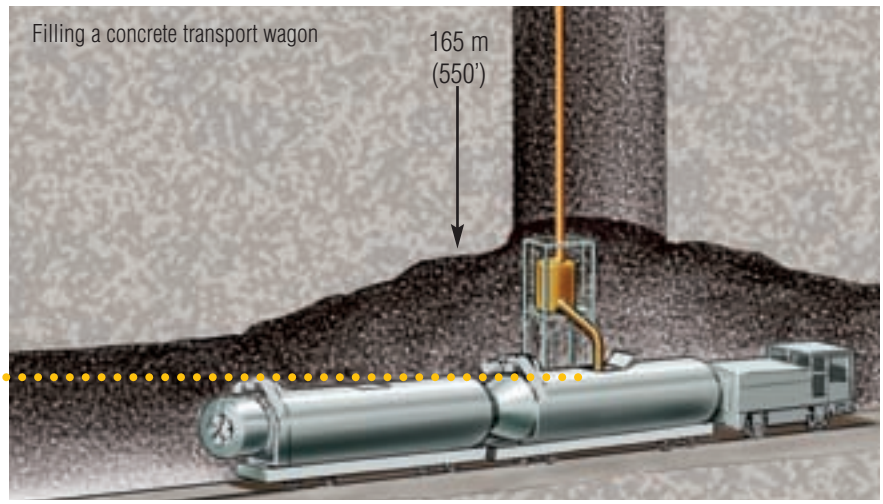

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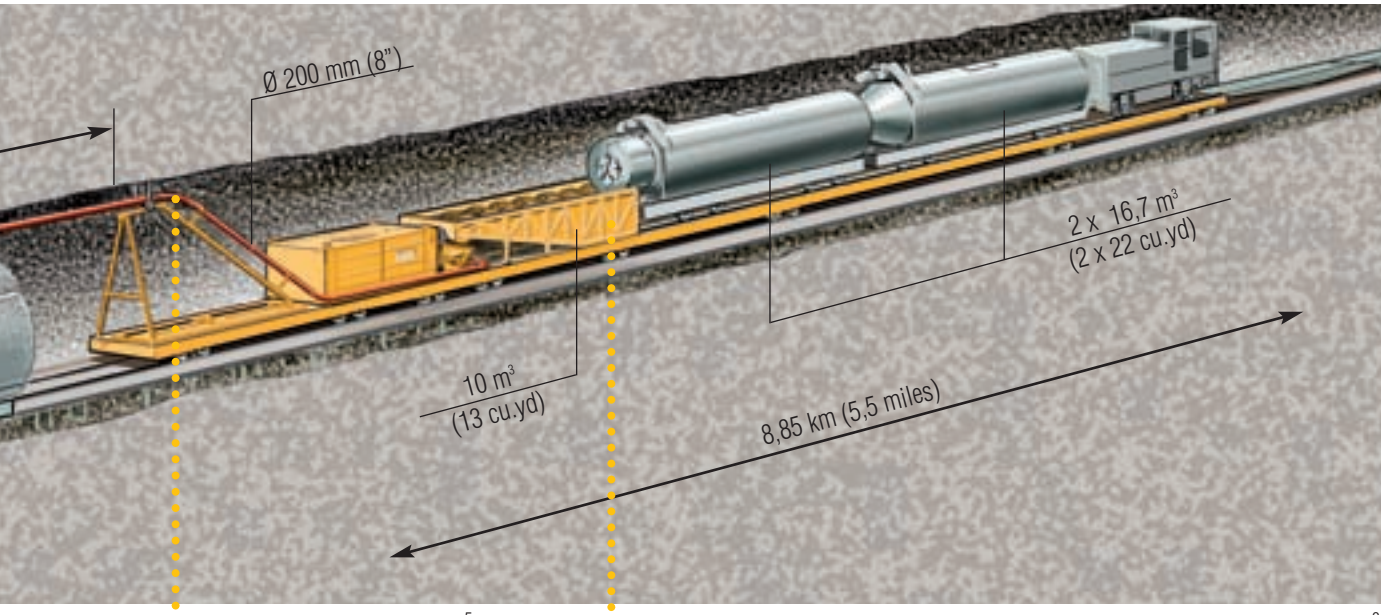

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The delivery line is guided on roller bearings in the roof

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The Jumbo trough serves as an in-line mixer and "collecting vessel" for the concrete that is delivered in batches

Even concrete with unfavourable grading curve was pumped

The concrete aggregates were up to 40 mm in diameter. The average grain was not often encounted. The aggregates were exclusively crushed material. Retarder and super plasticizer were added for respectively three hours of reaction time. One concrete batch was composed of the following:

Cement	298 kg (658 lbs)
Water	138 l (36.5 gal.)
Sand	592 kg (1305 lbs)
Aggregate 19 mm	524 kg (1155 lbs)
Aggregate 38 mm	349 kg (770 lbs)
Stabilizer	5.61 kg (19.8 oz)
Super plasticizer	7.48 kg (26.4 oz)

Concrete pumps adapted to job site conditions

A great deal was expected from the large Putzmeister concrete pumps for the delivery of a total of 68,000 m^3 (90,000 cu. yd.) The best achievement of one of the two BSAs was a daily performance of 752 m^3 (990 cu. yd.). The concrete pumps were alternatively in operation five days a week, round the clock in 3-shift operation, and were neither cleaned nor switched off from Monday morning to Friday evening. The machines were driven by 160 kW electric motors and had a stroke of 2100 mm and 230 mm delivery line diameter via a stroke volume of 87 l per delivery cylinder. PM had already designed the long-stroke pumps ex-works to especially convey concrete with coarse grain aggregates. The S-transfer tube of the BSAs therefore had for example an extremely large suction opening on the cylinder side – 230 mm (9") diameter which was reduced to a delivery line diameter of 200 mm (8"). Due to the large cross-sections and the considerable piston stroke, the flow velocity was reduced and the wear on the pump and pipeline minimised.

The concreting team quickly found the appropriate nickname for this largely-dimensioned concrete pump – "Big Mouth Pump".

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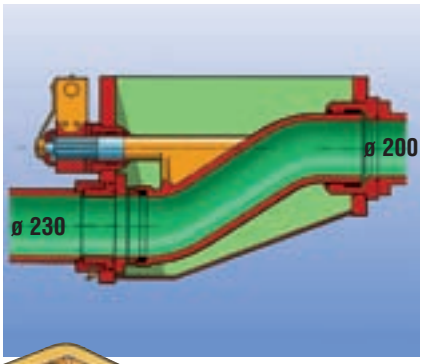

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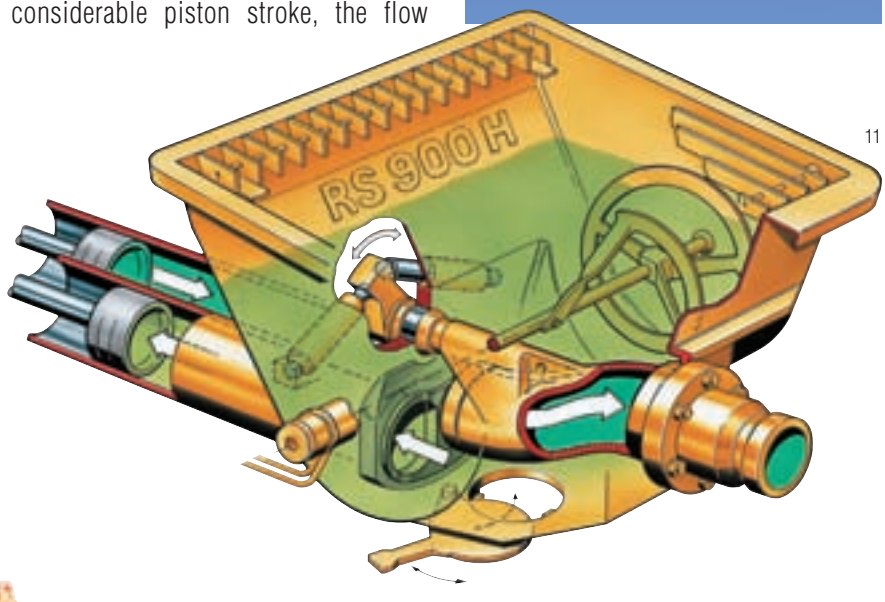

Sectional drawing through the S-transfer tube of the BSA concrete pump. Large cross-sections make it easier to suck-in coarsely grained aggregates

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The concrete pumps are maintenanced after four weeks of continuous operation.
The photo shows a "stand-by" pump which is kept waiting above ground.

Market Technique Fields
Concrete Technology PCT · Mortar Technology PMT
Pipe Technology PPT · Water Technology PWT
Industrial Technology PIT · Belt Technology PBT
Underground Technology PUC

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