Microtunneling machine completes a 110m radius curve in dense urban context

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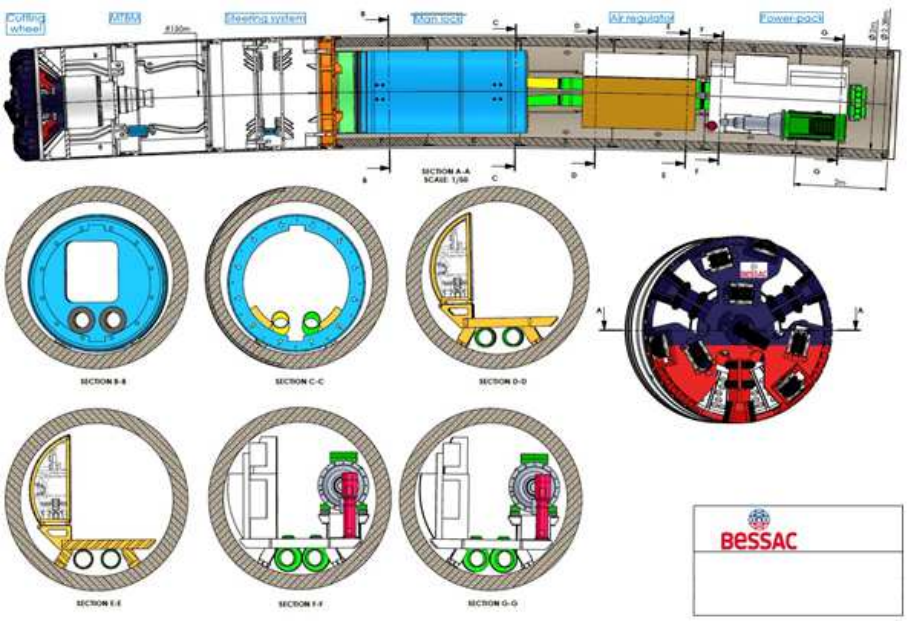
The plain of Rouailler in the city of Livry Gargan (suburbs of Paris, France) is subject to flooding directly affecting residents during the heavy rains. The county of Seine-Saint-Denis and its "Direction de l'Eau et de l'Assainissement" (DEA93) have launched the construction of a storm water collector main with an inside diameter of 2m and a length of 620m to reduce this risk. The project is to be carried out in the downtown where the ground space is very restricted.
The project provides the design of the new tunnel in 3 drives and the construction of 3 shafts. "Drive 3" presents the greatest difficulties, it must also pass under two important streets.

Layout of the new storm water tunnel

The angle between these two streets involves the requirement to make an intermediate shaft but this was not possible for the presence of the railway. The DEA 93 provides a tunnel with a 2,2m diameter made by a tunnelling boring machine MTBM. The tunnel-boring machine technique made it possible to achieve this section with a 110m radius curve and remove the shaft.

The tunnel boring machine provides:

- a short micro tunnelling boring machine and a specific module at the rear equipped with articulation cylinders to double the articulation;
- a shorter reinforced concrete jacking pipes (1.5m) to reduce the rigidity of the tunnel in the curve;
- a specific hydraulic joint system between each jacking pipe with computer monitoring of thrust forces and the openings between pipes. This guarantee the water tightness and the joints for radius of curvature of up to 93m;
- Computer modelling of the tunnel upstream to optimize the alignment and take this curve in a more viable geometric layout.



3D modelling of the MTBM and back-up equipment in a very tight curve

The cutting wheel, which is fixed to the shield, defines the direction of the excavation. The machine is connected to the shield by means of an active articulation. This active articulation includes steering cylinders, that allow the control of the joint, helping to excavate curves until a determined curve radius.

The MTBM was guided by a gyroscope system (planimetry) coupled to an electronic water level (altimetry).

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The accuracy of the position of the MTBM at the end of the drive was very good: less than 2 centimetres difference observed in altimetry and planimetry.

This project demonstrates the importance of anticipating the hazards inherent to these specific works, through the implementation of specific equipment and methods.