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AWARDS 2019**



## Toulouse Line A underground stations extension



**Anne-Laure BRAZIER – Tisseo Ingenierie**



## Stakeholders:



**Client:** TISSEO INGENIERIE

**engineer:** ARCADIS/Puig Pujol Associés/Betem

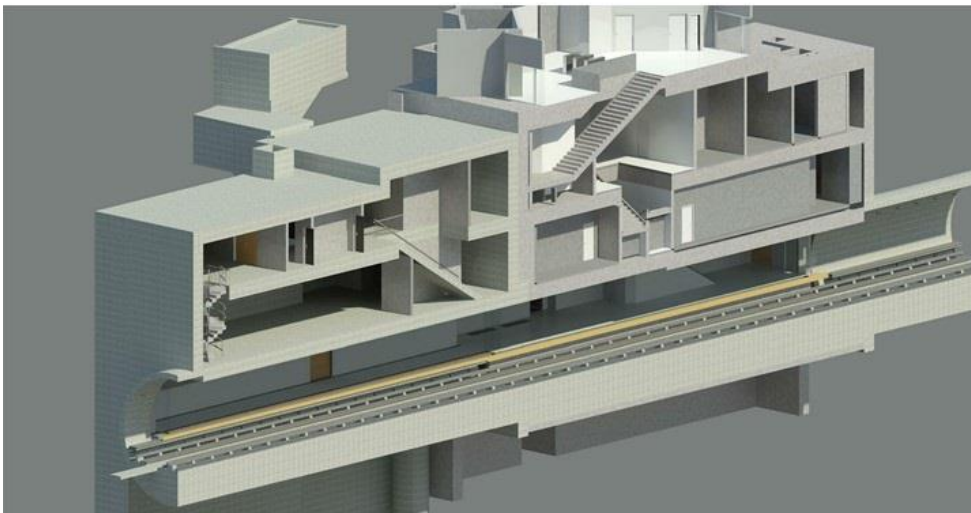
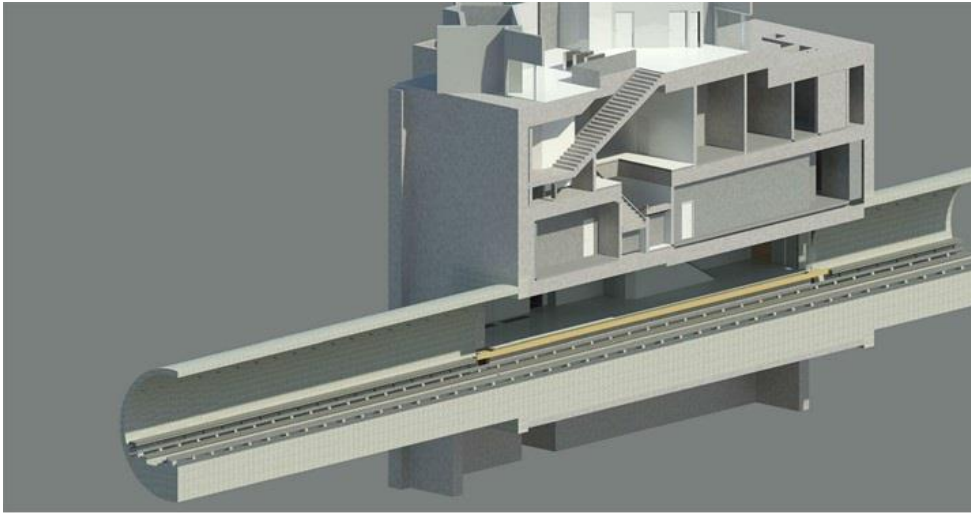
**Contractors:** EIFFAGE GENIE CIVIL / I.CO.P SPA / BG Ingénieurs Conseils /  
Forézienne d'entreprises / Fontanié

**Technical control office:** SOCOTEC

**Assembler:** SIEMENS



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<https://www.youtube.com/watch?v=Ae-c7t2uCX0&feature=youtu.be>



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**Our ambition was:**



« 100 % »



**to limit any inconvenience for the passengers**



**to guarantee the security**



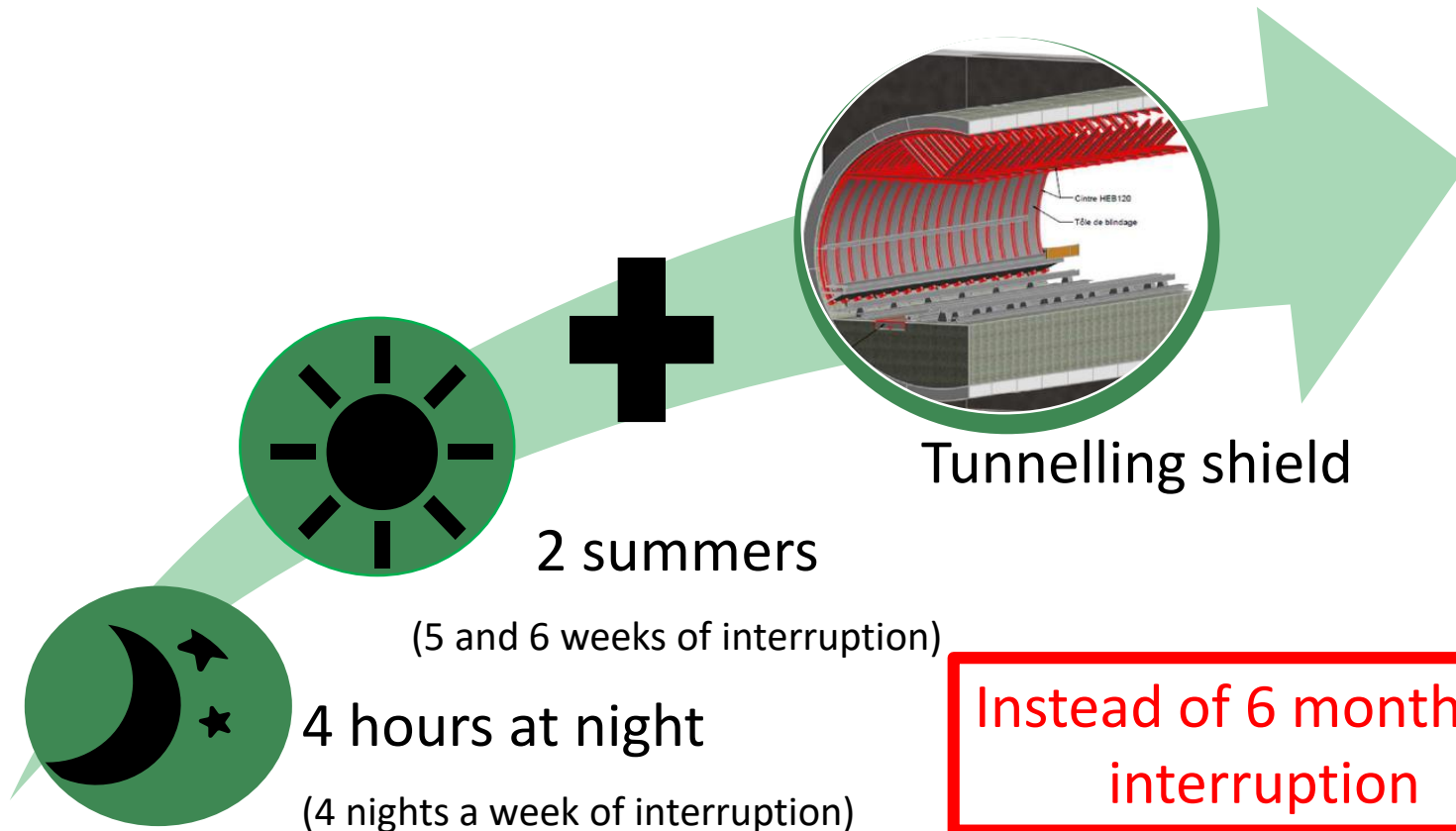
**to minimize the disturbance on the very urban environment**



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To limit any inconvenience for the passengers

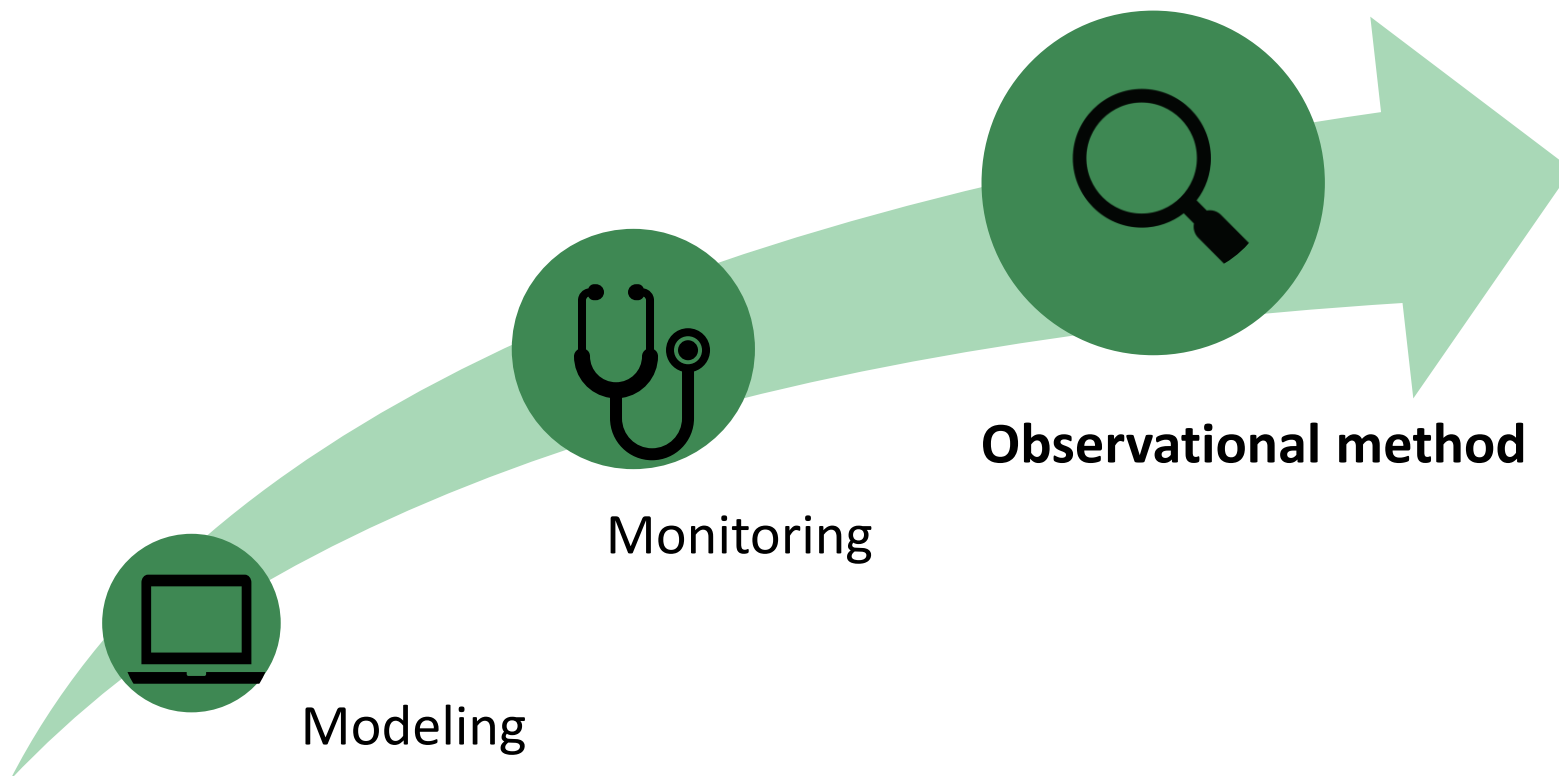




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**To guarantee the security = technical control**





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To guarantee the security : technical control /Modeling



- Special geotechnical studies and investigations
- Definition of the soil parameters to be incorporated in the soil/structure interaction models.

⇒ Excavation base heave = 1cm



**track tolerances**



⇒ **Observational method**





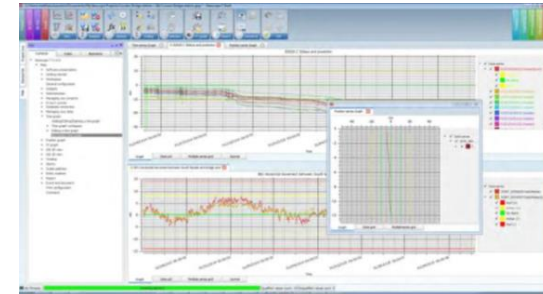
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**To guarantee the security : technical control /Monitoring**



- automated and continuous monitoring system with real-time warning system connected to the subway command post
- topographic monitoring of the track and slab along with a comparator tracker
- periodic visual inspection of the tunnel slab.







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**To guarantee the security : technical control /Monitoring**





## To guarantee the security : technical control /Observational method

- Definition of response scenarios depending on the displacements
  - Variation of the actions from simple visual inspection to complete stop of circulation.
- ⇒ Measuring instruments allowed to follow the decompression of ground and showed consistency between the 3D model theoretical displacements and the real measurements.
- ⇒ Observation of the fast stabilization of the uplift phenomena
- ⇒ periodic topographic checks will confirm this stabilization.



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## To guarantee the security : Analysing works methods



- design phase: identification of all the works interfacing with the operation of the metro
- Analyse of their impacts to specify the operating conditions in the contractors' contracts
- Continuing of these analyses during the construction phase by adjusting the construction methods and materials.



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**In conclusion, as a technical project innovation, the specificity of the project is:**

- removal of the tunnel lining,
- cohabitation between a civil engineering site and an automated electromechanical system,
- research of steering, design, contracting and construction methods and combined efforts of the Client, the Designer and the Contractors.



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