



Forrestfield Airport Link project – Variable density TBMs to deal with unexpected ground conditions

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The Forrestfield Airport Link (FAL) is a new rail service to Perth's eastern suburbs, connecting the existing Midland line to a new at-grade station in Forrestfield. This landmark transport project will enhance the existing network by providing three new stations connected via twin-bored tunnels whose entire length is 8.5 km. The Contract to design and construct the FAL project was awarded by the Western Australian Government to Salini Impregilo-NRW JV in April 2016. The beginning of the underground works was in 2017 with the launch of the two TBMs.



Forrestfield Airport Link rail route © www.forrestfieldairportlink.wa.gov.au

The route underpasses four critical points including rivers, highways, rails and airport runways. The risk of crossing these sensitive areas together with the high variety of the geological context has determined the choice of a Variable Density (VD) TBM. VD TBMs represent a new generation of soft ground machines that combine the two basic soft ground technologies: Slurry mode and EPB mode. In the Slurry mode the face support is provided by slurry counter pressure, namely a suspension of bentonite pumped into the excavation chamber, otherwise in the EPB mode the same excavated debris is used to support the tunnel face whilst it is being mixed with special additives. The choice of the mode depends on the ground conditions in order to keep safe and stable the excavation face.

As VD TBMs are a great innovation in tunnelling world, only highly experienced Constructors can cope with complexity and difficulties in managing this new kind of TBMs. After award of Contract, JV experts together with Herrenknecht, have been studying potential solutions and

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modifications to be applied, which than brought to conclusion that TBMs currently used in Perth are unique and there are no TBMs built in that way till date. In particular, it was decided to introduce further innovations focusing mainly on adjustments of Slurry Mode.



Variable Density TBM used in FAL project © www.forrestfieldairportlink.wa.gov.au

After careful studies, it has been decided that 2 tanks will be implemented in the TBM. These tanks, together with additional pump of polymer, will create special slurry mix with very high properties, called High Viscosity Slurry. Tanks are connected directly with excavation chamber and can be used during mining and/or during TBM stoppage for any reason, for example in case of significant drops of slurry levels in working chamber. Many slurry tests have been performed to define slurry mixes to be used depending on alignment and geology.

As designing and managing a VD TBM is a multidisciplinary matter, it can be argued that very different competences are necessary for this work, not only in underground structures but also in geotechnics and mechanical engineering.

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