

HOW DOES THAT WORK?

TUNNEL BORING NAVIGATION



With no surface reference points, underground surveying requires specialised skills in order to gain trustworthy accuracy for the surveying team
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Tunnel surveyors use techniques developed from the mining industry, including theodolites and levels. These are supplemented by tape measures and plumb bobs (latterly laser plumbs) down shafts, or headings to transfer survey coordinates underground.

More recently, 'total station' laser theodolites have been used which accurately measure distance, with the added advantage that a laser beam, once set correctly, can provide a continuous reference point for the position of a tunnel boring machine (TBM).

A beam is picked up by targets at the back of the TBM, and can present on a screen showing the TBM driver the location and attitude (tilt or skew) in real time compared with the planned, pre-programmed position. The driver can then vary the thrust on the hydraulic rams which drive the TBM forward to gradually maintain or correct the position.

To cope with curved alignments in the tunnel, to avoid obstacles and to cancel out some of the refraction effects in a hot tunnel, prisms are introduced on the sides of the tunnel to deflect the beam. New total stations are set up as the tunnel progresses with constant checking and rechecking until a suitable baseline is obtained or the survey can be closed and checked on the surface at another shaft or opening.

Without the ability to access satellite GPS data, underground gyro theodolites can help by providing a reference line underground in relation to true north.