

**Rectangular TBM for Urban Pedestrian Subway Construction by  
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On 8 June 2023, AGS(HK) organized a webinar on Rectangular Tunnel Boring Machine (RTBM) technology, which was presented by Ir. K M Chiang of Shanghai Tunnel (HK) Co., Limited. This report summarises the issues discussed during the seminar.

Ir. Chiang presented the RTBM technology as an efficient solution for pedestrian subway construction in urban areas. The seminar pointed out the traditional difficulties of underground space development in urban areas, including congested work sites, unfavourable working environments for workers, water ingress due to poor waterproof grouting, and soil collapse during underpass construction. Earth Pressure Balance (EPB) RTBM could be a solution to these difficulties.

Advantages of RTBM over conventional circular TBM were highlighted, including minimization of excavation volume as the non-circular TBM cross-section is often more in line with the designed tunnel use, minimization of impact to existing structures due to satisfactory settlement control, occupying less working site area, and having better alignment control. However, RTBM is unsuitable for sites with deep overburden, hard ground conditions, or for long tunnels, as the productivity would be undermined.

Essential features of RTBM were introduced, including the major machine components, jacking system setup, layout of pressure sensors and foam/bentonite injection ports on the cutter head, and typical segment arrangement. Typical RTBM operation work workflow was also discussed, including assembly in launching shaft, site logistics, segment casting, segment transportation, and segment manoeuvre with gantry cranes and turning devices.

The construction performance of RTBM in a Hong Kong project was presented in detail, including face pressure, jacking force, ground settlement recorded during RTBM advancement. For construction of a 130m long pedestrian subway, it required 210 days for preparation works like metal formwork manufacturing, segment casting, and RTBM set-up works-, and it followed by about 100 days for boring and post grouting works. The drive advance rate ranged from 1.1m/day to 2.1m/day. If conventional tunnelling method of excavation with horizontal

pipe piles (HPP) was adopted, Ir. Chiang expected that it would take more than 300 days longer, due to the slower excavation rate of 0.3m/day, as well as the longer preparation stage for HPP installation and subsequent waterproofing and RC works. The construction period would be doubled.

Based on past projects in the Mainland China, Ir. Chiang pointed out that RTBM was also suitable for wide-spanned vehicular underpass or metro construction. Ir. Chiang presented a case history of wide-spanned vehicular underpass construction by RTBM in Shanghai, where an 86m long underpass was successfully constructed by with RTBM technology underneath the existing trunk road. RTBM had satisfactory performance in settlement control to within 10mm.

In another project for metro tunnel construction, RTBM managed to form curved alignment and adapted well to the large variation in overburden. A built-in segment erector was also added to the RTBM to assemble the lining during advancement.

In conclusion, the seminar introduced RTBM as a good option for tunnel construction. However, RTBM is not recommended for sites with large overburden, hard ground conditions, or for long tunnels.