LEADING SAFETY PRACTICE 0086/30062023

SAFER CROSS PASSAGE CONSTRUCTION USING JACKED BOX

MAJOR TRANSPORT INFRASTRUCTURE AUTHORITY

The jacked box system improves ground stability and eliminates the need for workers to be located in close proximity to the cross-passage excavation.

Jacked box technology was used on the West Gate Tunnel Project to excavate cross passage tunnels.

Precast box segments create a continuous protective shield improving ground stability during excavation works.

A remote-controlled excavation arm eliminates the need for workers to be located in close proximity to the excavation.

Front view (left) and side view (right) of box jacking machine.

The Situation

On the West Gate Tunnel Project, there are 21 cross passage tunnels that connect the two main tunnels. They are an important safety feature that allow people and emergency services to move from one tunnel to the other in the event of an emergency.

The typical methodology for the construction of cross passages between tunnels in soft ground conditions are cut-and-cover, mining methods, or a combination of these methods. However, on the Westgate Tunnel Project, cut and cover was not feasible. Mining methods require ongoing stabilisation through shotcrete and rock bolts as the excavation progresses, which exposes the excavator operator and other workers to risks including uncontrolled material movement and dust generation.

The Solution

The CPBJH team identified jacked box technology as appropriate for the cross-passage ground conditions. Following ground improvement works and breakout of the tunnel segment wall, the box jacking machine was positioned at the exposed opening. A remote-controlled arm excavated the ground. The box jacking machine was propelled forward by pushing a precast concrete box against it. Spoil material was transferred from the base of the excavator to a skip bin located behind in the tunnel via a conveyor system.

Precast box segments were added behind the machine as soon as the jacking chamber was clear from the previous box. Bentonite was pumped in between the jacked box and the ground to reduce ground resistance. Once the cross passage was complete, grout was pumped behind the precast elements, displacing the bentonite and creating a waterproof barrier around the shaft.

Benefits and learnings

The jacked box technology had not previously been used in Australia. It was sourced from China Railway Engineering Equipment Co. Ltd. who provided skilled specialists to train local personnel.

The innovative system has been proven to be effective for the excavation and construction of cross passages in soft, less stable ground conditions. The remote-controlled excavation arm of the box jacking machine eliminates the need for workers to be located in close proximity to the excavation and the potential ingress of soil.

Additionally, the precast box segments create a continuous protective shield around the excavation. This has the dual benefit of maintaining ground stability around the excavation and enabling effective dust extraction via a scrubber system, further reducing any dust load within the broader tunnel environment.

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Program Office: West Gate Tunnel Project
Work Package: Tunnel Zone
Solution vendor: China Railway Engineering Equipment Co., Ltd.

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