

A new pattern for controlling pressure in earth chamber in shield tunneling and its experimental investigation

† Feng Ying ^{1*}, Li Shouju ¹, and Shangguan Zichang²

¹ State Key Laboratory of Structural Analysis for Industrial Equipment, Dalian University of Technology, Dalian 116024, China.

² Institute of Marine and Civil Engineering, Dalian Ocean University, Dalian, 116023, China

*Presenting author: lishouju@dlut.edu.cn

†Corresponding author: lishouju@dlut.edu.cn

Abstract

Shield-driven tunnels are widely adopted in the development of underground spaces for transportation and utility networks in soft soils. Pressure in soil chamber during shield tunneling controls working face stability and ground deformation. Excavating soil mass adopting Earth Pressure Balance (EPB) shield has been successfully implemented for many years. Some accidents occurred in shield tunneling and induced road collapse and building fracture because illogical pressure control appears. One of core problems in EPB shield is how to control pressure in soil chamber of shield in a given domain by adjusting rotating speed of screw conveyor and by utilizing some optimal algorithm. Appropriate pressure in soil chamber of shield can ensure ground deformation minimization and prevent soil loose during excavating. EPB shield provides continuous support to the tunnel face utilizing the fractured soil which is fulfilled in the soil chamber of shield after conditioning by adding some agents. The change of pressure in soil chamber versus time has time-delay characteristics because the fractured soil in soil chamber has viscosity and plastic properties. A new pattern for controlling chamber earth pressure in shield tunneling was proposed to achieve speediness and stableness in controlling process. The rotating speed of screw conveyor and thrusting speed of shield were determined as controlled variables in this investigation. The chamber earth pressure in shield tunneling is adaptively and automatically controlled. The adjusting thrusting speed of shield can be more effective to control chamber earth pressure because the diameter of shield cutterhead is larger than one of the screw conveyor. The experimental results show that the proposed new control strategy can increase speediness and stableness in comparison with singly adjusting rotating speed of screw conveyor.

Keywords: shield machine, chamber earth pressure, control pattern, adaptive control