

Study on History of Shield Tunnel for Sewage Systems and an Investigative its Evaluation

Whole term

2006.7 ~ 2007.3

Text P.127~P.133

(Purpose)

In Japan, shield tunneling method has played an important role as a typical tunnel construction method now. Shield tunneling method has achieved rapid development which correspond to construction conditions of complication and diversification in recent years ,because it has acquired mainly technological developments of sewage pipe construction ,in addition ,it had built up a closed-face type shield method ,such as earth pressure balanced shield method and slurry shield method mud water types ,it had constructed the combined manual excavation shield method with pneumatic method type for 10 years from 1975 former.

This study aims to prepare a technical document that objectively shows the significant contribution of sewage works in the development of shield tunneling method through the investigation, organization and analysis of historical transitions of shield tunneling technology.

(Results)

A large number of important and turning point technologies had been developed and practically applied at each period (invention, introduction, growth, maturation, and over-maturation) of the historical transition of shield tunneling method from its invention to the present date. Among these, sewage works has contributed to the following 5 groups of technology that remains in use today.

① Overwhelming share of sewage works in overall shield construction

The quantity and cost of projects bring out the wisdom of engineers engaged in shield tunneling business, and these nurture knowledge and ideas to further improve the tunneling technology. Moreover, the number of projects and social climate during the high-growth period boosted realization of these technologies. Figure 1 shows the transition of shield tunnel construction proportion.

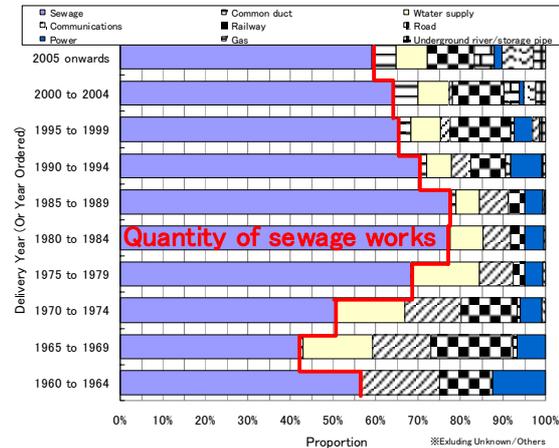


Figure 1: Transition of shield tunnel construction from 1960 to 2006 (Record of 7 shield manufacturers: 7302 deliveries)

② Issuance of “standard segment for shield construction”

Commoditization and standardization of knowledge regarding design and execution method including the concept of forces acting on the shield or segment and structural calculation method was promoted, and a foundation for shield technology was created.

③ Development and progress of earth pressure balanced shield

Face stability is important in having a safe and secure shield construction. Shields have shifted from open shield machine, and currently the earth pressure balanced shield method and slurry shield method have become the popular ones. In recent years, 70% of constructions from 1996 to 2005 have been muddy soil pressure shield. Muddy soil pressure shield was first constructed for the sewage work field and it can be said that this has contributed to its development and progress.

④ Disclosure of ground deformation and house damage condition accompanying shield tunneling method

Environmental issues such as ground deformation and house damage brought about by shield tunneling responded to by disclosing the damage condition and this contributes to the edification and it can be said that this further develops the technical capabilities of employers and engineers.

⑤ Contributes to development and practical application of technology and products essential to today’s shield tunneling method

The following “firsts” describe the contributions of sewage works in shield tunneling method.

- Shield tunneling : first to adopt earth pressure balanced shield method and slurry shield method
- Elemental technology : first to use copy cutter, and first to adopt articulation unit and simultaneous back filling grouting system.
- Lining : first to adopt single-pass joint in a wedge joint structure, and secondary lining applied segment
- Execution technology : first to adopt flexible section shield tunneling, continuous shield, The parenthesis shield, and T-BOSS mechanical shield docking

Sewage work business will continue to contribute in development and cost reduction of technologies such as the increasing depth of tunnels, combined secondary lining segment, compact shield tunneling method and others.

Researchers: Masayuki Matsuura, Toru Meguro, Sejiro Matsumoto, Takeshi Okamoto

Key words

shield tunneling method, history of shield tunneling, sewage works