An Investigation on the Performance of the Sealing Gaskets Used in Shielded Tunnels in Taipei MRT Projects

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Summary

The gasket designed and specified in the contract should have had the capability theoretically to seal the ground water. However, when constructed, due to some unanticipated and uncontrollable factors, leakage spots could be present at the lining segment joints. It is important to study the performance of the installed gaskets in the built tunnels. This paper documents the field observation conducted in Bid A and Bid B in one of the Taipei MRT lines. The 8mm thick gasket was used in Bid A, while the 9mm thick in Bid B. For both projects, the number of leakage spots was recorded at 24 hours, 15 days, 30 days, and 60 days duration. After being identified, the leakage spots were grouted using the OH-A waterproof sealant. An analytical comparison on the performance of the sealing gaskets between the two projects is conducted with respect to construction quality, time and cost. The results show that the modified gasket performs much better than the original one.

Keywords: shielded tunnel; sealing gasket; lining segment; MRT

1. Introduction

A tunnel has to be waterproof to ensure minimum maintenance and operating safety as well as to protect the expensive electro-mechanical installations housed in the tubes. The main consideration of shielded tunnel waterproof measurement is to prevent water leaking from segment joints. Focusing on the segmental lining, the most important parameters to achieve water tightness are to define the maximum allowed gap and off-set between two segments, to limit the distortion in the radial joints (ring build tolerances) and to limit segment tolerance for profile and groove [1]. Although tolerances for the erection of the tunnel lining have to be limited, however, when constructed, due to some unanticipated and uncontrollable factors, the allowable tolerances cannot be achieved to prevent water leakage. Thus, it is important to study the performance of the installed gaskets in the built tunnels.

2. Research purposes

This paper documents the field observation conducted in Bid A and Bid B in one of the Taipei MRT lines, the Sanchung-Luchou line, indicated in Figure1. The 8mm thick gasket was used in Bid A, while the 9mm thick in Bid B. The research purposes are:

1. to perform the field survey of water leakage between segment joints for Bids A and B shielded tunnels.
2. to conduct an analytical comparison on the performance of sealing gaskets between the two shielded tunnels with respect to construction quality, time and cost.

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3. Comparative analysis

Table 1 indicates that, at the 60 days, the 9mm thick gasket performs four times better than the 8 mm thick gasket. The time and cost required to inject OH-A into the leakage spots in Bid A and Bid B are shown in Tables 2 and 3. For the 9mm thick gasket, the time saved is about 79 days and the cost saved is about NT$ 800,000 over the 8mm thick gasket.

Table 1: Quality comparison between Bid A and Bid B

Bid #	Bid A（Original gasket）		Bid B（Modified gasket）	
Leakage	Inbound	Outbound	Inbound	Outbound
60days	1676 spots	1725 spots	654 spots	602 spots
Leakage ratio	51 spots/seg	53 spots/seg	13 spots/seg	12 spots/seg
Average leakage ratio	52 spots/seg		12.5 spots/seg	
A：B	4.16		1	

Table 2: Time comparison between Bid A and Bid B

Bid #	Bid A				Bid B			
Time	Inbound 544 rings		Outbound 544 rings		Inbound 845 rings		Outbound 845 rings	
Leakage spots	Minutes	Hours	Minutes	Hours	Minutes	Hours	Minutes	Hours
1676	50280	838						
1725			51750	863				
463					13890	232		
463							13890	232

Table 3: Cost comparison between Bid A and Bid B

Bid #	Bid A				Bid B			
Cost (NT$)	Inbound 544 ring		Outbound 544 ring		Inbound 845 ring		Outbound 845 ring	
Leakage spots	Unit price	Total price	Unit price	Total price	Unit price	Total price	Unit price	Total price
1676	649	1087724						
1725			649	1119525				
463					649	300487		
463							649	300487

4. Conclusion

Although a well designed gasket is specified in the contract, unless it is installed under reasonable construction tolerance, its anticipated performance cannot be guaranteed and satisfying behaviour cannot be achieved. The many different Taipei MRT projects give an opportunity to test and improve the originally specified gasket. Through field survey of two projects, the modified gasket can improve construction quality, time and cost substantially. The experiences gained from this study are presented as a reference for future modification of shield tunnel related construction specifications.

5. References

[1] SCHURCH M., “Small But Important – Gaskets for Tunnel Segments”, *International Symposium on Underground Excavation and Tunnelling*, 2006, pp. 239-248.