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Seepage in tunnel stability

L'infiltration au niveau de la stabilité du tunnel

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1 INTRODUCTION

Two topics were addressed as a panel discussion in the Tunneling Session: the one is the effect of seepage forces on the tunnel face stability and the other is the effect of slurry penetration phenomena on the face stability of slurry-shield tunnels.

2 EFFECT OF SEEPAGE FORCES ON THE TUNNEL FACE STABILTY

The stability of a tunnel face is one of the most important factors in tunnel excavation. Especially, if a tunnel is located under groundwater level, groundwater may flow into the tunnel face and seepage forces acting on the tunnel face due to groundwater flow may seriously affect the stability of the tunnel face.

Figure 1 shows the total support pressure obtained by summing up the effective support pressure and the seepage pressure. From this figure it can be seen that the seepage force seriously affects tunnel face stability. While the effective overburden pressure is reduced slightly by the arching effect during tunnel excavation, the seepage pressure remains the same. This is the reason why the effect of seepage pressure is significant in tunnel face stability problems.

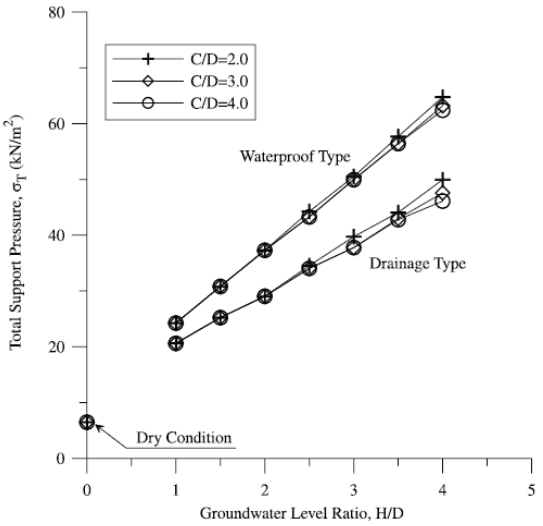

Figure 1. Change of support pressure with variation of the *H*/*D* ratio

3 EFECT OF SLURRY PENETRATION ON THE FACE STABILITY OF SLURRY-SHIELD TUNNELS

In the slurry shield method; a world widelyused tunneling method in saturated and shallow soil cover, the stability of working face depends essentially on the rheological characteristics of slurry penetration into the ground, and the attention was drawn to it.

The slurry penetration was assessed by soil-filter clogging theory to understand the rheological characteristics. The coefficient of fine particle deposition, represented as an indicator of slurry clogging during tunnel construction, was estimated through several series of modeling experiments shown in Figure 2.

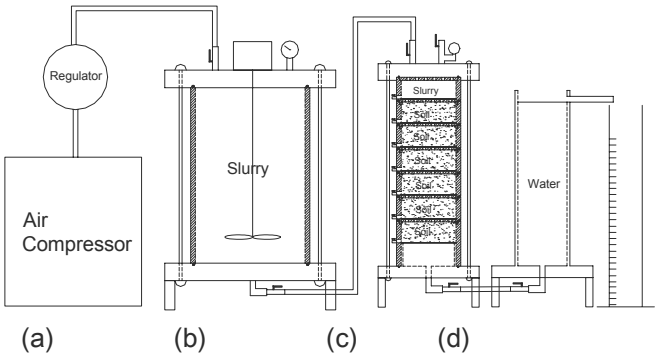

Figure 2. Overall view of the experimental apparatus

Experimental results showed that the ratio of infiltration velocity to the coefficient of particle deposition was reciprocally proportional to the penetration distance and proportional to the stability of tunnel face. It was also found that the critical d_{10} which needs the special additive was 0.75mm. In addition, considering the advance rate of tunneling in stability analyses, the discussion was further to find the relationship between the tunnel advance rate and the stability of working face due to slurry penetration.