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Ground-born vibration at multileveled train tunnel crossing

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ABSTRACT

In recent railway projects where the railway connects between cities, newly planned tunnels are often located close to, or beneath an existing tunnel. Many claims and petitions have voiced public concern about the vibration and noise resulting from the situation. Vibrations and noises are engineering issues as well as environmental problems, and have become more important as people have become more concerned with their the quality of life. However, it is unlikely that the effects of vibration in situations where trains simultaneously pass a multileveled tunnel crossing have been appropriately considered in the phase of planning and design. This study investigates the superposition characteristic of ground-born vibrations from a multileveled tunnel crossing. The results from model tests and numerical analysis show that the ground-born vibration can be amplified by a maximum of about 30% compared to that resulting from the existing single tunnel. Numerical parametric study has also shown that the vibration amplification effect increases as the ground stiffness, the tunnel depth, and the distance between tunnels decrease.

1. INTRODUCTION

Complex underground-railway networks operate in many metropolitan cities. In this case, situations where tunnels are multilevel-crossed can occur and the ground-born vibration generated by trains is problematic for residents adjacent to the tunnel crossing. Serious social conflicts between residents and project owners can be raised.
The problems of vibrations in railway tunnels have been generally studied for a single tunnel using theoretical approaches, field measurements, laboratory tests (Aiello et al.

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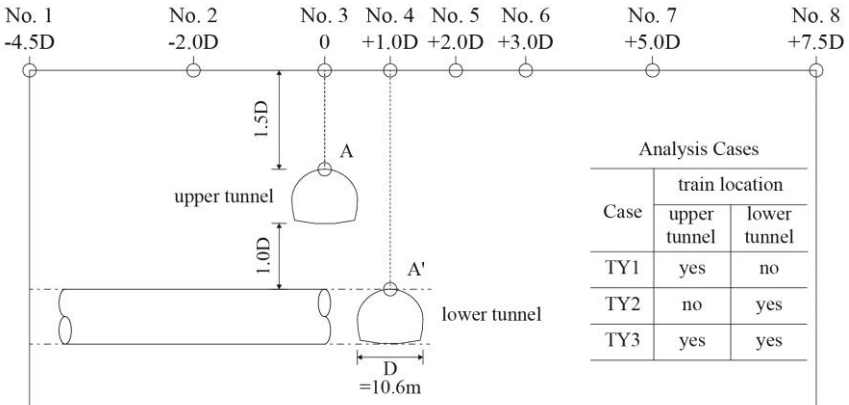
2008), empirical methods and numerical methods (Gupta et al. 2010). However, neither practical regulation nor an evaluation method on the effect of vibration superposition when trains simultaneously pass the tunnel crossing has been reported yet. This study investigated the superposition characteristic of vibrations and the engineering significance of the vibration amplification at the tunnel crossing.

2. ANALYSIS CASES

The vibration superposition in the actual tunnel crossing will be influenced by various factors such as ground stiffness, tunnel depth, and distance between tunnels. In this paper, the effect of these factors on ground-born vibration was investigated by performing a numerical parametric study. A tunnel crossing in the Seoul metropolitan area was considered for the analysis (Shin et al. 2011). Fig. 1 shows the cross-section at the tunnel crossing. A total 12 cases were analyzed considering different ground condition, tunnel depth, and distance between tunnels.



Analysis Cases

Case	train location	
	upper tunnel	lower tunnel
TY1	yes	no
TY2	no	yes
TY3	yes	yes

Fig. 1 Model for analysis cases

3. CONCLUSIONS

The characteristics of vibration superposition at the tunnel crossing were investigated in terms of ground stiffness, tunnel depth, and distance between tunnels. The numerical parametric study showed that the vibration amplification effect increased as the ground stiffness, the tunnel depth, and the distance between tunnels decreased.

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