

**Heaving of Roadbed by Swelling of Ground in Mountain Tunnels
and its Countermeasures**

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Some mountain tunnels suffer from heaving of roadbed in service and require some countermeasures. Countermeasure designs often depend on empirical methods, therefore designing reasonable countermeasures becomes a significant problem. In this study, swelling of ground was focused on as one of the causes of roadbed heaving, and the model experiments and numerical analyses were carried out. The model experiments and numerical analyses could reproduce the time depending heaving behavior of the roadbed in the actual tunnels. Also it was confirmed that downward rock bolts improve the stiffness of the invert and suppress the heaving of the roadbed. Furthermore, we performed numerical analyses changing the number, diameter and length of rock bolts and the value of pre-stress, and evaluated those effects on heaving of the roadbed quantitatively.