

**An Effect and a Design Method of Rock Bolts as Countermeasures
for Roadbed Heaving of Mountain Tunnels**

Kazuhide YASHIRO Keisuke SHIMAMOTO

Yusuke NAKANISHI Yoshiyuki KOJIMA

In some tunnels, a roadbed heaves due to geological causes after opening to traffic. In many cases, roadbed rock bolts are used for countermeasures for heaving. On the contrary, we usually design roadbed rock bolts experientially because standard specifications, such as arrangement of bolts, are undefined. In this study, the authors performed case studies, model tests and numerical analyses to clarify the effect of roadbed rock bolts, and to establish the design method. The conditions, under which roadbed heaving occurs are clarified by case studies. The mechanism of the roadbed heaving and the effect of rock bolts are clarified by model tests. Furthermore, we carried out numerical analyses for the in-situ tunnel with the practical numerical analysis method, and the effective reinforcement pattern is clarified, and we proposed standard specification.