

**Prediction of Floor Heave and Evaluation of Its Countermeasures of Existing Mountain Tunnels  
by Consistent Numerical Analysis Executed Starting from the Excavation Stage**

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Some mountain tunnels suffer from floor heave after their completion, and some of them require countermeasures against it. In this study, first, the construction data of Shinkan-sen tunnels suffering from floor heave are analyzed. Second, tunnel construction, floor heave during service and its countermeasures are modeled for the numerical analysis. Additionally, the effect of the items of the specification of downward rock bolts such as the number of bolts, their diameter, length and the value of prestress are evaluated quantitatively. As a result, it has been found out that with respect to the application of rock bolts as countermeasures against the floor heave during service, well-balanced specifications of the bolts considering the surface bonding and yielding of the bolts are important for securing the long-term performance of the countermeasures.