



## **Shallow slope stability analysis for earth cut slope of high-rank highway in high latitude seasonally frozen regions**

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When a high-rank highway is built in quite hilly seasonally frozen regions, it is inevitable to excavate the mountain. This activity damages the surface vegetation and cuts off the runoff passage of groundwater, and consequently affects the intrinsic ground stress equilibrium of the slope body, leads to the redistribution of ground stress and the heat balance change in the near-surface of the cut slope. With effect of the air precipitation in autumn and the chill climate in winter, the ground water accumulates in the near-surface of earth cut slope and lead to the frost heave on the surface. During the thawing period in spring, with effect of integrated factors including rainfall and increasing temperature, ice kernels on both the surface and the near-surface of cut slope thaw fast. As a result, the water content in the near-surface partly is high enough to cause saturation or even over-saturation, and accordingly the intrinsic effective stress on the slope body decrease. With effect of gravity, the near-surface of slope collapses partially or entirely and slides downwards to produce a landslide on the highway slope, which often occurs as well as in the roadbed and the side slope constructed by earth fills. The landslide seriously influences the road landscape and even endangers the safety of transport. Based on the limit equilibrium principle, method of fixed value analysis and reliability analysis, this paper built stability analysis models for earth cut slopes. For high-rank highways affected by the seasonal freeze-thaw cycle, combined with ground data of freeze-thaw collapses on cut slopes, the paper conducted the stability analysis considering water and temperature changes on the shallow slope. The changing rule of factor of safety of the slope stability, which related to slope surface load, slope ratio, thawing depth of shallow slope and shear strength of near-surface soil, was investigated. Finally, rational suggestions were proposed for designing shal-

low slope protection to defense earth cut slopes on high-rank highways in seasonally frozen regions.