

封闭与开放抛石路堤降温效果及机理对比试验研究

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摘要 在多年冻土地区道路工程的修筑与维护中, 所面临的最大问题就是冻土问题, 抛石路堤对其下伏土体具有冷却降温的作用已得到公认。通过室内试验比较分析了封闭与开放抛石路堤结构降温效果及降温机理差异。试验结果表明: 开放结构降温速度快, 而封闭结构对外界温度变化相对不敏感, 比较而言降温速度较慢, 但从长远来看, 在试验条件下, 其降温能力要强于开放结构。同时, 对抛石层顶底温差与其顶部温度变化关系以及抛石内温度场特征的分析, 发现两种路堤结构在降温机理上存在着明显差异, 封闭结构主要依靠内部空气自然对流强弱变化引起等效导热系数的变化来实现对其底部土层的降温作用; 开放结构则主要依靠外界低温风的作用在其内部形成强迫对流, 以强化传热的方式来实现降温。但实际工程中由于多种因素的影响往往导致两种对流方式同时并存, 因此对于年平均气温低于0℃的多年冻土区而言, 两种抛石路堤结构均应具有良好的应用前景。

关键词 [岩石力学](#); [封闭与开放](#); [抛石路堤](#); [降温效果](#); [降温机理](#)

分类号

CONTRAST EXPERIMENTAL STUDY ON COOLING EFFECT AND MECHANISM BETWEEN CLOSED AND OPEN RIPRAPPED-EMBANKMENTS

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Abstract

In construction and maintenance of road engineering in cold regions, permafrost has been the mainly influencing factor in embankment stability. The cooling effect of the riprapped embankment on the soil beneath has been recognized. In this paper, the differences of the cooling effect and mechanism between the closed and open riprapped embankments have been compared through the laboratory test. It can be concluded that the cooling rate of the open model is faster than that of the closed one, but as far as a long-term effect is concerned, the closed one's cooling capability is larger under the condition of the experimental temperature. Furthermore, by analyzing the changing correlation between the top temperature and the temperature difference through the top and bottom of the riprapped layers, taking consideration of the temperature field in the riprapped layers, it is found that the cooling mechanisms of the two embankment models are quite different from each other. Namely, the cooling effect of the closed embankment model on the soil beneath mainly relies on the changing of the thermal conductivity of riprapped layer, which is caused by the changing of the inside nature convection, but that of the open model relies on the way of heat-transfer enhancement because of the inside forced convection induced by the low temperature wind outside. But the two ways of convection exist together

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because of the effect of many factors in actual engineering; therefore, both of the two models have good application perspective in permafrost regions where mean annual air temperature is subfreezing.

Key words [rock mechanics](#); [closed and open condition](#); [riprapped embankment](#); [cooling effect](#); [cooling mechanism](#)

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