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现场环境下混凝土冻融耐久性预测方法研究

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摘要 已有的冻融研究积累了大量标准试验数据，但由于现场冻融环境和室内冻融环境间的巨大差异，大量标准冻融试验数据难以直接应用于现场混凝土冻融耐久性预测。如何利用混凝土冻融标准试验数据模拟现场冻融环境下混凝土的冻融过程并给出冻融耐久性预测是工程实践中迫切需要解决的问题。首先分析室内外冻融环境的差异，在室内外混凝土材料性能(包括微孔结构性能)一致的前提下，对现场混凝土频繁接触水的情况进行研究。从疲劳损伤机制出发，利用Miner损伤累积法则和损伤等效原则，结合现场实测气温资料模拟现场混凝土冻融过程，建立能够联系实验室冻融和现场冻融的等效室内冻融循环次数公式，提出利用等效室内冻融循环次数和标准冻融试验数据预测现场混凝土冻融耐久性使用年限的方法。预测值与十三陵水库现场数据和北方部分港口工程现场数据的比较表明预测方法能够得到符合工程预测需要的结果。

关键词 岩土力学；冻融；耐久性；疲劳损伤；Miner 损伤累积法则；温度变化速率；预测

分类号

RESEARCH ON PREDICTION METHOD OF CONCRETE FREEZE-THAW DURABILITY UNDER FIELD ENVIRONMENTS

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Abstract

Lots of standard freeze-thaw experimental data cannot be directly used to predict freeze-thaw durability of concrete in field because of difference between laboratory and field environments. How to simulate the damage development process of concrete under freeze-thaw cycles in field by the standard freeze-thaw experimental data in laboratory and then to obtain a prediction of concrete freeze-thaw durability is necessary for engineering. The difference between laboratory environment and field environment is analyzed firstly，and then it is assumed that concrete pore distribution is relative constant and concrete in field is placed in saturated environments. On the base of mechanism of fatigue damage，the Miner¢s damage cumulative principle and equivalent principle are used to simulate freeze-thaw damage process of concrete in field by climatological data. The obtained formula can be used to calculate equivalent numbers of freeze-thaw cycles in laboratory by the numbers of freeze-thaw cycles in field，which can connect different freeze-thaw environments in laboratory and field. Using standard freeze-thaw experimental data and equivalent laboratory freeze-thaw cycle number，the freeze-thaw life of concrete in field can be predicted. The prediction results comparing with field data of concrete structures in Shisanling Reservoir and some ports in North China are satisfied.

Key words rock and soil mechanics；freeze-thaw；durability；fatigue damage；Miner¢ s damage cumulative principle；temperature variation rates；prediction

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