

学术论文

冻融与氯盐侵蚀作用下预应力结构耐久性试验及数值模拟

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摘要: 为探索预应力混凝土结构在侵蚀环境作用下的耐久性,通过对12根预应力混凝土梁在不同冻融循环次数后进行的氯离子侵蚀试验,主要研究影响冻融与氯盐侵蚀环境下结构耐久性的因素。针对季节性冰冻地区的预应力海工结构耐久性失效特点以及结构耐久性具体要求,综合考虑正负峰值温度差与预应力的影响,提出了冻融条件预应力结构氯盐侵蚀的耐久性分析模型,通过工程实例验证模型的可行性。研究表明,采用Crank-Nicholson格式差分进行数值模拟,模拟结果与实际工程检测结果吻合较好;预应力水平和冻融循环次数是影响预应力混凝土梁氯离子扩散的主要因素,冻融损伤严重缩短结构的使用寿命,预应力延缓了混凝土冻融损伤;冻融循环次数越大,扩散深度越深;对于冻融损伤度为24%的混凝土,其氯离子扩散所需的时间是未损伤混凝土的15%~25%。

关键词: 预应力混凝土结构 冻融循环 氯盐侵蚀 耐久性 损伤

Durability test and numerical analysis of prestressed structures with cyclic freeze-thaw subjoining chloride attack

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Abstract: To understand the durability of prestressed concrete(PC) structures in corrosive environment,the influence factors of structure durability in chloride attack and cyclic freeze-thaw were studied,based on experimental results for 12 specimens of PC structures in chloride corrosion after different freeze-thaw times.Focusing on durability failure of prestressed marine structures and requirements on structural durability in seasonal ice regions,the durability analysis model of PC structures with cyclic freeze-thaw subjoining chloride attack was suggested,according to the influence of positive and negative peak temperature difference and prestressing force.The feasibility of the presented model was validated by practical projects.It is found that the numerical simulation results are in good agreement with measured results by Crank-Nicholson Difference.The prestressing level and cyclic freeze-thaw times are the main influence factors of chloride diffusion for PC structures.The results indicate that structure service life is sharply shortened by freeze-thaw damage,and concrete freeze-thaw damage is delayed by prestressing level.The diffusion depth is deeper with cyclic freeze-thaw times.The required time of diffusion for concrete with the freeze-thaw damage up to 24% is about 15%~25% of that for the undamaged concrete.

Keywords: cyclic freeze-thaw chloride attack durability damage

收稿日期 2010-04-05 修回日期 2010-04-05 网络版发布日期 2010-04-05

DOI:

基金项目:

国家自然科学基金项目(50878098,50908103)

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