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海底隧道钢筋混凝土基于氯盐腐蚀的耐久性参数设计研究

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摘要 胶州湾海底隧道是中国自行建造的第二条海底隧道，其服役寿命为100 a。在详细分析海底隧道结构混凝土的服役环境基础上，参考国内外现有的寿命预测模型，依据混凝土耐久性试验结果和重大工程类比，综合考虑混凝土碳化、混凝土初始氯离子浓度影响等因素，建立了海底隧道混凝土在双重破坏因素作用下的寿命预测模型。通过上述模型进行计算，计算结果表明：(1) 海底隧道要达到100 a服役寿命，其衬砌混凝土靠近空气一侧保护层厚度应大于70 mm，靠近土体一侧应大于60 mm；(2) 混凝土初始氯离子浓度应小于0.15%；(3) 氯离子扩散系数应小于4×10－12 m2/s，水胶比w/b应小于0.34，混凝土强度等级应高于C50。此外，依据混凝土耐久性能与其配合比、原材料之间的定量关系，提出海底隧道100 a服役寿命的混凝土配合比设计和原材料优选原则。

关键词 海底隧道；寿命预测模型；混凝土；耐久性

分类号

STUDY ON DURABILITY PARAMETER DESIGN OF SUBSEA TUNNEL REINFORCED CONCRETE BASED ON CHLORIDE CORROSION

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Abstract

Kiaochow Bay subsea tunnel is the second self-building tunnel in China with the designed service life over 100 years. On the basis of service environment of subsea tunnel concrete，the durability experiments of concretes are conducted and concretes are compared with those of other major engineering cases. The prediction modeling of service life considering concrete carbonation，initial chloride contents and chloride diffusion in concretes is proposed. Considering the requirement of 100 years service life of subsea tunnel，the modeling parameters are calculated according to prediction modeling of service life. The results show that cover thickness of lining concrete，which faces to atmosphere，should be more than 70 mm and those of other sides should be more than 60 mm. The initial chloride concentration in concrete should be less than 0.15% of binding materials；and chloride diffusion coefficient of lining concrete must be less than 4×10－12 m2/s. Moreover，the water to binder ratio w/b of lining concrete should be less than 0.34 and strength grade higher than C50. Based on quantitative relationship between durability of concrete and mixture proportion，raw materials and the principle of mixture proportion designed as well as raw materials choice are given based on 100 years service life of subsea tunnel.

Key words subsea tunnel；prediction modeling of service life；concrete；durability

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