



有粘结和无粘结相结合的预应力FRP筋混凝土梁抗弯承载力研究

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THE FLEXURAL CAPACITY OF CONCRETE BEAMS PRESTRESSED WITH BONDED AND/OR UNBONDED FRP TENDONS

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摘要 纤维增强塑料筋(简称FRP筋)是一种高强弹性材料,非常适合用做侵蚀环境下的预应力筋,采用有粘结和无粘结相结合是提高预应力FRP筋混凝土梁延性的一种新方法。对有粘结和无粘结相结合的预应力FRP筋混凝土梁的抗弯承载力进行了理论分析和试验研究,基于平衡配筋率定义了有粘结和无粘结相结合的预应力FRP筋混凝土梁的破坏形态,推导了平衡配筋率和相应抗弯承载力的计算公式。为了验证公式的正确性,进行了9根预应力FRP筋混凝土梁的试验研究,计算结果与试验结果吻合良好。研究表明,在相同配筋的条件下,体内有粘结预应力FRP筋混凝土梁的承载力最高,体内无粘结预应力FRP筋混凝土梁的承载力其次,而无转向块的体外无粘结预应力FRP筋混凝土梁的承载力最低。采用体内有粘结和无粘结预应力相结合,可以改善预应力FRP筋混凝土梁的延性。

关键词: FRP筋 预应力混凝土梁 平衡配筋率 抗弯承载力 延性

Abstract: Fiber reinforcement polymer (FRP) has high strength and high stiffness-to-weight ratio, which owns potential to be used as prestressing tendons in corrosive environment. However, concrete beams have showed brittle flexural failure due to the elastic rupture of FRP tendons. In order to improve the ductility, a combination of bonded and/or unbonded prestressing tendons is used. The flexural capacity of concrete beam prestressed with bonded and/or unbonded FRP tendons has been studied theoretically. According to the definition of balanced ratio, the failure modes of concrete beams prestressed with FRP tendons were defined in this paper, and the balanced ratio and the corresponding formula for calculating the flexural strength were derived. In order to verify the correctness of the formula, a series of flexural tests were conducted on 9 concrete beams prestressed with bonded and/or unbonded FRP tendons. The test program validated the proposed method. The results of experiments show that, if the reinforcement of prestressed beam remains the same, the concrete beam prestressed with bonded FRP tendons has the highest carrying capacity, followed by the unbonded prestressed beam, while the external unbonded prestressed beam without deviators has the lowest carrying capacity. Through combination of different FRP tendons, the ductility of concrete beams prestressed with FRP tendons can be improved.

Key words: FRP tendons prestressed concrete beams balanced ratio flexural capacity ductility

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