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### 新型玻璃纤维增强塑料砂浆锚杆的黏结性能试验研究

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**摘要** 锚杆广泛应用于隧道、边坡、地下洞室开挖及支护工程中。通过锚杆的支护加固, 岩土体的强度和稳定性能够得到显著的改善和提高。传统的钢锚杆在不良地质条件下存在锈蚀严重的缺点, 给支护结构的安全性和耐久性带来严重威胁。玻璃纤维增强塑料具有轻质、高强、耐腐蚀等优良特性, 是代替钢筋制作锚杆的理想材料之一。在经典拉伸试验模型的基础上, 结合锚杆本身的受力特性, 建立一种改进的拉伸试验模型, 并且根据此试验模型, 对直径分别为10, 13, 16 mm的表面经过喷砂和缠绕纤维束处理的玻璃纤维增强塑料锚杆, 以及直径为25 mm的螺纹钢进行拉伸试验, 试样的总数量为24组。试验采用强度等级为C60的混凝土模拟岩体, 并采用强度等级分别为41.5, 55.5 MPa的砂浆作为锚固剂。在试验结果基础上, 对玻璃纤维增强塑料锚杆的拉拔破坏模式、临界黏结长度、拉拔承载力、平均黏结强度以及与钢锚杆拉拔性能的比较进行研究讨论, 对砂浆锚固玻璃纤维增强塑料锚杆的黏结性能进行系统全面的分析评价, 为推广玻璃纤维增强塑料锚杆的工程应用、相关规范的制定, 以及进一步研究工作提供一定数据储备和理论支持。

**关键词** [岩石力学](#) [玻璃纤维增强塑料砂浆锚杆](#) [改进拉伸试验](#) [破坏模式](#) [临界黏结长度](#) [拉拔承载力](#) [平均黏结强度](#)

分类号

## EXPERIMENTAL STUDY ON BOND BEHAVIOR OF NEW TYPE CEMENT GROUTED GFRP BOLTS

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### Abstract

Bolt is widely used in slope engineering, tunnel, and large cave supporting as well as restoration of engineering structure. It can improve the strength and stability of ground, rock mass, and other structures. The traditional steel bolt has some disadvantages, such as easy corrosion, heavy weight, and difficult operation. Glass fiber reinforced polymer(GFRP) is impervious to chloride ion and low pH chemical attack, and its tensile strength is much larger than steel while with lighter weight. Those advantages make it a better alternative in some fields of engineering. To utilize GFRP bars as rock bolt, some aspects of its behavior, such as bond strength in mortar, bearing capacity, and bond stress distribution along its interface, have to be examined. This paper presents the research on bonding behavior of anchor bolt made of GFRP bar, and concrete block is used to model rock mass in laboratory. The modified pull-out tests were conducted on selected GFRP bars and compared with steel ones that were grouted with mortar in concrete blocks. The diameters of the GFRP test samples are 10, 13, 16 mm respectively, and the steel one is 25 mm. There total 24 samples are tested. The surface of the GFRP bar is sprayed with sand and wound with fibers. The compressive strength of concrete which is used to simulate the rock mass is 58.3 MPa; and the compressive strength of two kinds of mortars are 41.5 and 55.5 MPa, respectively. According to the results, bond characteristics of mortar grouted GFRP rock bolts such as failure modes, bearing capacity, critical bond length, average bond strength, and comparison with steel bolt were evaluated. The research will give a support to the application of GFRP bolt.

**Key words** [rock mechanics](#) [Glass fiber reinforced polymer\(GFRP\) bolt](#) [modified pull-out test](#) [failure mode](#) [critical bond length](#) [bearing capacity](#) [average bond strength](#)

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