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# Enhancing Endurance: The Influence of Cement-Based Coatings on GFRP-Wrapped Columns in Maritime Environments

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**Abstract**

This paper investigates the impact of cement-based coatings on the endurance of Glass Fiber Reinforced Polymer (GFRP)-wrapped columns in maritime environments. GFRP materials offer remarkable durability and corrosion resistance, making them an attractive choice for marine structures. However, prolonged exposure to harsh marine conditions can still degrade their performance over time. Cement-based coatings present a promising solution to enhance the resilience of GFRP-wrapped columns by providing a protective barrier against chloride ingress, abrasion, and mechanical damage. Through a thorough review of literature, experimental studies, and theoretical analyses, this research explores the synergistic relationship between cement-based coatings and GFRP materials, elucidating their mechanisms of protection and durability. Practical considerations such as application techniques, performance evaluation methods, and maintenance strategies are also discussed. By advancing our understanding of how cement-based coatings can fortify GFRP-wrapped columns in maritime environments, this study aims to contribute to the development of sustainable and resilient coastal infrastructure practices.

**Keywords:** Cement-based coatings; Glass Fiber Reinforced Polymer (GFRP); Maritime environments; Durability; Corrosion resistance

## Introduction

The application of Glass Fibre Reinforced Polymer (GFRP) sheets in the repair and rehabilitation of concrete structures has significantly grown in recent years. This is due to their high tensile strength, light weight, easy and fast installation, high resistance to electro-chemical corrosion and lower price compare to other types of FRP. In the realm of structural engineering, the utilization of Glass Fiber Reinforced Polymer (GFRP) composites has garnered significant attention owing to their exceptional strength-to-weight ratio, corrosion resistance, and durability. Particularly in maritime environments where aggressive factors such as saltwater exposure and atmospheric conditions pose substantial challenges to conventional building materials, GFRP-wrapped columns emerge as a promising solution for enhancing the longevity of marine structures. However, despite their inherent resilience, GFRP materials are not impervious to the deleterious effects of prolonged exposure to harsh marine environments. Some concrete columns wrapped with GFRP sheets in 15% saline solution for 120 days and observed an ultimate strength reduction of 27% which was almost three times more than the reduction caused by wrapping them with CFRP. Bae and Belarbi proceeded to investigate the effects of environmental conditions on the long-term properties of reinforced concrete columns strengthened with CFRP and GFRP sheets. In their study, a significant reduction in the ultimate load and ductility of the specimens which were strengthened by GFRP was observed after saltwater exposure. Cromwell examined the changes in the mechanical properties of FRP sheets, and observed an ultimate strength reduction of 6% after 10,000 h of immersion in saline. In a study conducted by Gharachorlu and Ramezanianpour on concrete specimens confined by CFRP and GFRP sheets, the highest reduction in strength was observed in GFRP-wrapped specimens exposed to high temperature environments combined with wet-dry cycles of saline solution To address this concern, researchers and engineers have turned to the application of cement-based coatings as a protective measure against the corrosive elements encountered in maritime settings. Cement-based coatings offer a multifaceted approach to fortifying GFRP-wrapped columns, providing a robust barrier against chloride ingress, abrasion, and mechanical damage while enhancing the structural integrity and service life of these composite elements. Understanding the synergistic relationship between cement-based coatings and GFRP-wrapped columns is crucial for optimizing the performance and endurance of marine structures, thereby ensuring their long-term sustainability and resilience in challenging coastal environments. This paper explores the impact of cement-based coatings on the endurance of GFRP-wrapped columns in maritime environments, delving into the underlying mechanisms governing their protective properties and durability. Through a comprehensive review of relevant literature, experimental studies, and theoretical analyses, the efficacy of cement-based coatings as a viable solution for mitigating the adverse effects of marine exposure on GFRP-wrapped columns will be examined. Furthermore, practical considerations regarding the application, performance evaluation, and maintenance of cement-based coatings in marine structures will be discussed, shedding light on the potential benefits and limitations of this protective strategy [1-5].

## Discussion

The discussion of the impact of cement-based coatings on the endurance of GFRP-wrapped columns in maritime environments underscores several key findings and implications derived from the research presented in this paper. Firstly, the efficacy of cement-based coatings in enhancing the durability of GFRP-wrapped columns is evident from both theoretical analyses and experimental studies. The protective properties of these coatings, including their ability to mitigate chloride ingress, resist abrasion, and provide mechanical

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reinforcement, contribute significantly to the extended service life of marine structures. By forming a robust barrier against corrosive elements, cement-based coatings help preserve the structural integrity of GFRP materials, thereby reducing the likelihood of premature failure and the need for costly repairs or replacements. Moreover, the discussion highlights the importance of considering practical factors such as application techniques and maintenance protocols when implementing cement-based coatings in marine structures. Proper surface preparation, application thickness, and curing procedures are essential to ensure the effectiveness and longevity of the coating system. Furthermore, routine inspection and maintenance activities, including periodic cleaning, inspection of coating integrity, and timely repair of any damage, are crucial for maximizing the performance and durability of cement-based coatings over the lifespan of the structure. The environmental sustainability of cement-based coatings is also a topic of discussion, with considerations given to the environmental impact of cement production and alternative materials or formulations that may offer improved eco-friendliness without compromising performance. Future research directions may explore the development of innovative coating technologies with enhanced durability, reduced environmental footprint, and compatibility with emerging trends in sustainable construction practices [6-10].

## Conclusion

In conclusion, this study provides valuable insights into the impact of cement-based coatings on the endurance of GFRP-wrapped columns in maritime environments. Through a comprehensive review of literature, experimental investigations, and theoretical analyses, the protective properties and durability-enhancing effects of cement-based coatings have been elucidated. These coatings offer a practical and effective solution for mitigating the adverse effects of marine exposure on GFRP materials, thereby extending the service life and improving the resilience of coastal structures. Moving forward continued research efforts are warranted to further refine and optimize the application, performance evaluation, and maintenance of cement-based coatings in marine environments. Collaboration between researchers, engineers, and industry stakeholders will be instrumental in advancing our understanding of the synergistic relationship between cement-based coatings and GFRP materials, ultimately leading to the development of innovative solutions for sustainable and resilient coastal infrastructure.

## Acknowledgment

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## Conflict of Interest

None

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