



Carbon Fiber Composite Cables for Gate Operation

ERDC Dredging Operations Technical Support Program (DOTS)

U.S. ARMY CORPS OF ENGINEERS

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Response Summary:

Robert Henry of the Operations Division in the Nashville District submitted a Dredging Operations Technical Support (DOTS) request for assistance in studying the feasibility of carbon fiber composite cables (CFCC) for gate lifting operations. ERDC researchers traveled for a site visit, assembled historical information, and conducted market research to determine the risks associated, identify site-specific challenges, and generate a rough estimate for the number and size of cables needed to meet simplified load requirements and EM-1110-2-2610 guidelines. A combination of 4 CFCCs (19 strand, 1.35-in. diameter) provide an ultimate strength of approximately 1,200 kips with a factor of safety (FS) of 8.8, meeting the Engineer Manual FS requirement of 5. This arrangement of CFCCs would provide a higher FS than the existing chain design using AISI 4140 steel, subject to known risks discussed in this report. Design challenges remain in balancing the minimum bend radius on a drum within the available space on the existing machine platform. Material challenges remain in production and testing standards as well as long-term mechanical and environmental performance.

Chains are included in the analysis of ERDC SR-24-3, "Composite Material Applications and Research Roadmap for US Army Corps of Engineers Civil Works," though at extremely low priority with a Normalized Combined Component Score in Table B-4 of 0.00 out of 10. The subjective assessment on page 75 of the Research Roadmap does not recommend consideration of composite materials for this application at this time, as applicable research and development would be required for a sound design, considering the conditions of mechanical creep and wet-dry cycles as well as the lack of applicable manufacturing and testing standards.

Period of Performance:

15 November 2023 to 30 September 2024

Benefits of the Response to the USACE Dredging/Navigation Program:

The Navigation program benefits from extended engagement and communication of composite material prototypes and conceptual designs in support of Engineering and Construction Bulletin 2024-08, "Design of Fiber Reinforced Polymer Hydraulic Composite Structures." Composite structures bring the potential to avoid hundreds of millions of dollars of lifecycle maintenance costs across the enterprise when compared with in-kind steel replacements of failing components. Additional details are available in the Composite Material Research Roadmap.

Deliverable:

The ERDC compiled a Letter Report in order to disseminate existing specific information and expand applicability of the solution across the enterprise.



Providing environmental and engineering technical support to the U.S. Army Corps of Engineers
Operations and Maintenance navigation and dredging missions

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