

ENT9099ME12 - Design and Development of Mobile Site Facilities Using Buses for tank construction projects

Principal Investigator

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Research Area and Specialization:	Specializes in the fields of Manufacturing, Design, and Composite Materials, with a particular focus on the development and analysis of composite structures and expertise extends to Finite Element Analysis, Project Management, Quality and Reliability Engineering, and Energy Policy and Economics and AI basic tools. My research encompasses innovative manufacturing techniques, material characterization, and the application of computational modeling to enhance the performance and reliability of engineering materials and systems. And actively contributes to advancing knowledge in these areas through his scholarly publications, funded research projects, and collaborative initiatives
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Background of the problem

Tank construction projects are complex and resource-intensive endeavors that require comprehensive planning and management of various site facilities to ensure smooth operations. Traditionally, such infrastructure is built on-site as permanent structures or temporary installations, which often involve significant time, cost, and logistical efforts.

However, traditional facility setup techniques face significant obstacles due to the dynamic nature of tank construction projects, which frequently include phased development or span many locations. When quick facility mobilization or relocation is required, permanent buildings can cause delays in project schedules due to their lack of flexibility. These facilities' building, disassembly, and transportation further raise expenses, have an adverse effect on the environment, and use more resources.

With increasing emphasis on project efficiency, sustainability, and cost reduction, innovative approaches are required to overcome these limitations. Mobile solutions, such as utilizing buses as adaptable, self-contained site facilities, present a promising alternative.

Despite the potential advantages, developing such transportable facilities that ensure structural safety, adequate space planning, environmental sustainability, and compliance with safety laws is challenging. By tackling these problems through effective design and engineering, site management practices in tank construction projects can be entirely changed.

This background highlights the necessity of creating transportable site amenities with buses to improve operational flexibility, lower costs, and encourage environmentally friendly building methods in the sector.

List of publications related to the field

N/A

Research Objectives and Expected Outcomes

Aim : Design and Development of Mobile Site Facilities Using Buses for tank construction projects

• Research Objectives:

1. To develop a thorough design framework for self-contained, transportable bus modules with offices, restrooms, storage, and shelters and necessary site features for tank construction projects.
2. Optimization of space utilization to ensure structural integrity and incorporate modern safety and environmental standards within the mobile facilities through detailed architectural and engineering analysis.
3. Enhancement of operational flexibility and reduce infrastructure dependence by designing modular, easily transportable units that enable quick deployment and transition across multiple construction sites.

4. Integration of sustainable technologies, including energy-efficient lighting and waste management systems, into the mobile site facilities to promote environmentally responsible construction practices.

Expected Outcomes:

The project's expected outcome is the development of innovative, efficient, and environmentally friendly transportable site amenities that significantly improve logistical flexibility, operational productivity, and safety standards in tank construction projects. These portable bus modules will provide easily deployable, self-contained facilities that facilitate more flexible and cost-effective construction activities across several locations, simplify site administration, and reduce reliance on permanent infrastructure.

Research Design & Methodology

1. Analysis of Requirements and Concept creation

- Conduct consultations with site supervisor to identify specific needs and operational requirements.
- Review existing site infrastructure and logistical challenges in tank construction projects.
- Define essential features for the mobile modules, including offices, restrooms, storage, shelters, safety equipment and any other requirement

2. Design and Analysis

- Develop conceptual designs of bus modules emphasizing modularity, space efficiency, and structural resilience.
- Using Solid works or any suitable CAD software develop a 3D model and interior design of the system.
- Perform structural analysis(stress analysis) and load testing simulations to validate structural robustness using analysis engineering software like ANSYS to ensure safety standards and structural integrity under operational conditions.

3. Prototype Development and Testing

- Develop a prototype of the bus modules based on the finalized designs.
- Perform transportation tests to assess mobility, stability, and ease of deployment.
- Evaluate internal layout functionality, safety features, and durability under operational conditions.

4. Integration of sustainable technologies

• Incorporate renewable energy sources, such as portable solar panels, where feasible. • Design waste collection and recycling systems adhering to environmental standards.
5. Implementation and Evaluation • Develop a standardized modular component with quick-connect capabilities to facilitate assembly and disassembly. • Deploy the mobile units at designated tank construction sites for testing. • Monitor operational performance, safety compliance, environmental impact, and user satisfaction.
6. Final review • Compile comprehensive documentation of the design process, testing results, and deployment procedures. • Provide recommendations for future enhancements.

Significance and potential impact of research in Bahrain

This research holds significant importance for Bahrain's construction and infrastructure sectors. As Bahrain rapidly develops, there's a growing need for efficient, flexible, and sustainable construction solutions. The development of self-contained, transportable modular units with offices, restrooms, storage, and site features can revolutionize site management by reducing reliance on permanent infrastructure, shortening setup times, and enabling quick deployment across multiple sites. This enhances operational flexibility and supports faster project completion, which is vital for Bahrain's urban expansion and industrial growth.

Integrating modern safety standards and environmentally friendly technologies such as energy-efficient lighting and waste management systems aligns with Bahrain's sustainability goals, reducing environmental impact. Additionally, designing resilient modules suited to Bahrain's climate enhances safety, durability, and site resilience.

The project fosters local innovation by encouraging skill development, supporting the growth of green construction practices, and positioning Bahrain as a leader in advanced construction technologies regionally. Overall, this research promotes sustainable, cost-effective, and adaptable infrastructure development, contributing to Bahrain's vision for smart urbanization and economic diversification. Its successful implementation can lead to safer, greener, and more efficient construction practices, supporting the country's long-term sustainable growth.

Alignment with Bahrain's national research strategy

The development of self-contained, transportable bus modules aligns closely with Bahrain's national research strategy and EDB policies by promoting innovation, sustainability, and economic diversification. The project supports Bahrain's Vision 2030 goals of sustainable development

through the integration of energy-efficient lighting and waste management systems, reducing environmental impact and supporting green construction practices. By optimizing space utilization and ensuring safety standards, it enhances construction quality and safety, aligning with national safety policies. The modular, easily transportable design reduces dependence on permanent infrastructure, enabling quick deployment across multiple sites, which supports Bahrain's focus on resilient and adaptable infrastructure development. Additionally, leveraging advanced engineering and architectural analysis demonstrates a commitment to research-driven solutions that improve operational efficiency. Overall, the project fosters innovation in construction logistics while promoting environmentally responsible practices, directly contributing to Bahrain's strategic objectives.