Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 05 Issue: 04 | April-2025

Vertical Lifting Bridge

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Abstract

This research explores the replacement of the Pamban Bascule Bridge in Tamil Nadu, India, with a vertical lift bridge. A vertical lift bridge provides better operational efficiency, lower maintenance, and higher load capacity, especially important for rail traffic. The paper includes comparative analysis, structural evaluation, and practical implementation of hydraulic actuated lifting systems to enhance the bridge's functionality and ensure seamless marine navigation.

New Pamban Bridge: India's First Vertical Lift Rail Sea Bridge

1. Introduction

Movable bridges play a pivotal role in connecting regions separated by navigable waterways. India's only movable bridge, the Pamban Bridge, uses a bascule mechanism, which is becoming increasingly inefficient due to aging components and rising traffic demands. This paper proposes a vertical lift bridge as a modern, sustainable alternative.

2. Existing Challenges

The bascule span of the Pamban Bridge limits traffic capacity and marine clearance. Mechanical failures, high maintenance, and energy usage further justify the need for modernization. Hydraulic lifting technology in vertical lift bridges addresses these shortcomings.

3. Types of Movable Bridges

Movable bridges include vertical lift, bascule, table, and swing types. Among these, vertical lift bridges offer optimal benefits for rail applications due to their fixed spans and heavier load tolerance.

4. Vertical Lift Bridge Design

Vertical lift bridges raise the deck vertically using counterweights or hydraulic jacks while maintaining horizontal orientation. This design is ideal for the Pamban site, with hydraulic jacks offering precise control and reliability.

5. Materials and Mechanisms

Prestressed concrete for the deck and piers improves structural durability. Hydraulic jacks and control systems ensure synchronized lifting. STAAD Pro simulations help in structural analysis.

6. Proposed Modifications

The new design includes replacing the bascule mechanism with a central lifting span supported by piers housing hydraulic pistons. This system increases the vertical clearance for ships and improves traffic flow.

7. Simulation and Analysis

Structural modeling using STAAD Pro shows reduced deflection and improved stress distribution with the new design. Bending moment diagrams and stress contours confirm the feasibility of vertical lift systems.

8. Benefits of Replacement

Key benefits include reduced power consumption, lower maintenance, increased waterway usage, and enhanced safety.

It also aligns with India's push toward inland waterway transport.

9. Conclusion

The vertical lift bridge concept presents a technologically superior, economically viable, and operationally efficient replacement for the aging Pamban Bascule Bridge. Its adoption will ensure future-ready infrastructure in a region of national significance.

10. References

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