

# Comparison of PowerArch<sup>®</sup> Bridge with Different Span Length

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**Abstract** - A bridge is an essential component of transportation infrastructure that enables the safe movement of people, vehicles and goods across natural and man-made obstacles. It improves connectivity, reduces travel time and supports economic and social development. Arch bridges have been an important part of human civilization due to their strength, durability and low maintenance. However, conventional masonry and RCC arch bridges are less preferred today because of complex construction processes, need for centring, vegetation over bridge and longer construction time.

To overcome these limitations, a modern system known as PowerArch<sup>®</sup> has been developed. This system uses High-Density Polyethylene (HDPE) pipes, Glass Fiber Reinforced Polymer (GFRP) bars, and self compacting concrete (SCC) reducing the need for steel reinforcement. This improves durability, corrosion resistance and sustainability while reducing construction time.

A 25 m single span Power Arch<sup>®</sup> bridge was successfully constructed within 67 days in Nagpur city. Load testing confirmed its structural strength and serviceability. This study focuses on the arch bridges by comparing different span lengths and highlighting the efficiency of the Power Arch<sup>®</sup> system as a modern, durable and sustainable solution for bridge construction.

**Keywords** - PowerArch<sup>®</sup> , HDPE pipes ,GFRP bars, Self Compacting Concrete (SCC), Durability, sustainable construction

## INTRODUCTION



Fig.1: Construction of PowerArch<sup>®</sup> Bridge

The PowerArch<sup>®</sup> system by PowerArch Innovations is a cast-in-situ, modular PCC arch bridge technology designed for long-span applications up to minimum 20m and beyond. Engineered for exceptional durability, the system eliminates the need for bearings, expansion joints, or structural steel resulting in a 120 plus year design life with minimal maintenance.

Its compression based structural form provides superior load bearing capacity has excellent resistance to corrosion and reduced environmental impact compared to conventional RCC, Steel or PSC bridges. PowerArch<sup>®</sup> offers a sustainable, cost-effective and aesthetically pleasing solution for both urban and rural infrastructure combining traditional arch strength with modern construction efficiency. In this study, two cases were considered namely

Case1: Single Span Bridge

Case2: Double Span Bridge

#### METHODOLOGY ADOPTED:

1. Study of PowerArch<sup>®</sup> bridge
2. Estimation the quantities of Power Arch<sup>®</sup> bridge (with different span length)
3. Comparison of different length of PowerArch<sup>®</sup> bridge.

#### ESTIMATION OF BRIDGE:

Bridge estimation is the systematic process of calculating the total cost of a project by analyzing every component from the initial excavation of soil and rock to the final aesthetic finishes. This process involves a detailed measurement phase where engineers quantify the specific amounts of earthwork, high-grade concrete (M50) and reinforcement steel needed for the foundation, piers, and arch. To ensure financial accuracy, a rate analysis is performed using the latest government standards (SSR 2022-23) which accounts for specialized tasks like underwater dewatering, high-altitude concrete pouring and modern drainage solutions. Beyond basic materials, the estimate incorporates logistical and statutory costs such as "Lead Charges" for transporting materials like steel and cement over long distances and "Royalty Charges" for using natural resources like sand and stone. To guarantee the bridge is safe and durable, the budget also includes a strict testing framework for checking the strength of concrete and steel, culminating in a final load test of the entire span. By combining these technical measurements with transportation overheads and quality control fees, the project creates a "Bill of Quantities" that ensures the bridge is both financially feasible and built to the highest engineering standards.

#### COST COMPARISON OF BRIDGE:

Total Cost of case 1: The total estimated cost of is ₹4.75 Crores.  
Total Cost of case 2: The total estimated cost of is ₹5.31 Crores.  
Difference in Cost: The difference between Case 1 and Case 2 is ₹0.56 Crores.

Major cost component of Case 1 and Case 2:

- The comparative analysis of Case 1 and Case 2 indicates that both bridge alternatives are structurally feasible but differ in cost, hydraulic performance and structural efficiency.
- Case 1, consisting of a two-span arch bridge with a central pier, is more economical with a total estimated cost of ₹4.75 crore and involves simpler construction techniques.
- Although Case 2 has a higher estimated cost of ₹5.31 crore due to the increased arch ring concrete quantity, it offers superior long-term durability, reduced maintenance and enhanced flood safety. Therefore, Case 1 is suitable from an economic and construction perspective, while Case 2 is the more optimized and efficient structural solution.



Fig 2: Complete PowerArch Bridge

#### CONCLUSION

Case 1 offers a more economical approach at ₹4.75 Crores, making it ideal for minimizing initial construction costs, while Case 2 provides superior long-term value through a 50-meter single-span design that improves structural efficiency and reduces flood risk by eliminating a central pier. Although Case 2 has higher initial costs due to premium materials, it delivers better durability and lower maintenance by reducing steel needs and optimizing hydraulic performance. Overall, Case 1 is best for budget-constrained projects, whereas Case 2 represents the superior engineering solution for environmental resilience and longevity.

#### FUTURE SCOPE

- Future studies can be carried out for different span lengths of PowerArch<sup>®</sup> bridges to determine the most economical and efficient design.
- Detailed structural analysis can be performed using software to study load carrying capacity, stress distribution and deflection under various loading conditions,
- Seismic and wind analysis can be considered in future to evaluate bridge safety in earthquake prone and high wind areas.
- Future research can include comparison of PowerArch<sup>®</sup> bridges with conventional RCC, steel and PSC bridges under similar site conditions.
- Optimization of construction methods can be studied to further reduce project time, labour requirement and equipment cost.
- Maintenance planning and life-cycle performance studies can be conducted for long-term service evaluation .

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