



A PAPER ON LITHELY ARCH BRIDGE

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Abstract

In this we are studying modern technology of arch bridges i.e “Lithely Arch technology”. In this technology the blocks are precasted, blocks are jointed with screed concrete and lifted to a location by transporting them on site and again lifted to form arch bridge and then working towards the finishing. It also includes the study of reading the drawing, Bearing capacity, prepared all over detailed estimate and stability checks. Various IRC codes, IS codes is studied.

The masonry arch is one of the oldest structural elements. Brick masonry arches have been used for hundreds of years. This technical note is an introduction to brick masonry arches. Many of the different types of brick masonry arches are discussed and a glossary of arch terms is provided. Material selection, proper construction methods, detailing and arch construction recommendations are discussed to ensure proper structural support, durability and weather resistance of the brick masonry arch. Lithely arch method is innovative, modern, economic and fastest method of construction of arch bridges. This method is invented in Maharashtra, India. Bridges constructed using this method are purely compressive in nature. This method utilizes precast units for construction of arch bridges. This method can be utilized for rehabilitation of old arch bridges in India very economically and with less time.

The lithely arch is India's only Precast, Unreinforced Bridge solution and is developed on the lines of the conventional stone-mason built arch bridges. Arch bridges are the most reliable and time tested solution for medium span (5m to 20m) bridges. These bridges have been standing strong for centuries and while they were initially designed for 8-10 tons of load are carrying modern vehicular load without any distress.

Keywords -Lithely Arch , Wire Rope , Concrete , Spandrel Wall , Sockets , Screed , Moulds , Strip .

Introduction

Arch Bridges are used form ages. Lithely Arch technology is the derived version of stone arch bridges. Stone arch bridges required more time in construction, and it also required accurate stone cutting (skilled manpower). These limitations were overcome in the Lithely Arch bridge.

The lithely arch is based on the same principles of the conventional arch bridge and requires absolutely no maintenance once installed. the bridge is designed to have a service life of over 120 years, almost twice that of modern bridge solutions.

Modern arch infrastructure, through lithely arch, retains the core functionality of arch bridges, while eliminating all inconveniences.

These bridges are strong enough to hold 8-10 tons of load which can carry a modern vehicular load without any distress.

Masonry arch bridges are part of our heritage. To preserve our heritage and to utilize these bridges to their maximum capacity, understanding of arch bridges is vital. As no more masonry arch bridges are being constructed in modern times, engineers have forgotten the old thumb rule methods of their design and also there are no common software available which can analyse the arch bridges correctly taking into account effect of fill, spandrel walls etc. The design of these structures was based on empirical rules which were too conservative, this has resulted in structures with an inherent ability to withstand the applied loads and extreme weathering conditions. Masonry arch bridges form an integral part of the railway infrastructure. They are the oldest structure type of the railway bridge population with thousands still in service despite their age and the significant changes in loading conditions that have occurred since their construction. Today many masonry arches carry a load that is radically different from that when they were constructed.

Objective

In absence of steel improves cost efficiency over conventional bridge solutions.

To minimize construction time by to rapid installation due to reliance on precast elements.

To calculate the detailed estimate and the design calculation of bridge.

To compare the structural, hydraulic and cost effectiveness of the various types of bridges with Lithely arch bridge.

To provide such type of design which have less maintenance cost and long service life.

CONSTRUCTION METHODOLOGY OF LITHELY ARCH BRIDGE

Footings must be prepared on each side of the structure. The attendant crane lifts each LITHELY ARCH strips and lowers it into position over the precast sockets laying a top the foundation / pier top the lithely strips arrive on site completely flat, laying upon flatbed transporters. The components includes the required number of arch strips based on the scope of the project, ready for lifting and placing in position precast concrete sockets act as the surface on which individual lithely arch strips are placed. These sockets are placed in line and level a top the piers, prior to the commencement of the erection activity. Once all strips have been positioned and placed, block masonry spandrel walls are constructed up to the road top level. Spandrels do not carry any traffic load but act as a permanent shuttering for the poured plain concrete acting as the back fill to the lithely arch strips. The bridge is then ready for roadway finishing and any railing protection that may require.

1) Steel Molds for casting of concrete blocks: The blocks which used in strip are made from concrete. For casting those blocks steel mold have been used. Steel mold will make as per the design of size of the block. Steel mold are used to get smooth surface and sharp corners.

2) Concrete blocks line and leveled: After the casting of blocks, the blocks are laid into in series. Blocks laid in series where gives length of the strip which used for arch.

3) Wire Rope for lifting: generally, the rope which will used in arch bridge it made of ferrous. Wire is consisting of numbers of small diameter. steel wire known as tendons. These wire rope is not part of structural member in the arch bridge. The main use of wire rope is to lift the arch strip.

4) Arch strip before screed and after screed: Successfully placing of the wire rope on the arch strip the top surface of the strip should be cover with the screed concrete. Screed it is the small thickness layer of concrete on the top of the strip of arch that is to cover the wire rope and the top surface.

5) Lifting of arch: From the casting place the arch strip will be transported to the site location by the transporter vehicle after the reaching the site the arch strip will be lifted by the cranes. During the lifting process, some precaution should be taken to account the arch strip will lifted in the proper manner. The blocks in the arch strip should not get damaged.

6) Arch placed on socket stabilized, no support required: Due to the design of the arch strip and the socket they both will balance their centre of mass. Design of socket will give the stabilized condition to the arch. Total weight of the strip will transfer to the socket and then to the foundation. All the strips will arrange parallel to each other.

7) Back filling procedure 60% rubble, 40% concrete: After the construction of both spandrel walls back filling will be done. It is used to fill the space between the arch and provide the level surface for the transportation. Also the main purpose of the filling is to increase the weight of the bridge. In this back filling 60% rubble and 40% concrete will be used and compact using vibrator. Generally, old arch bridges murrum was used but as we know that concrete stronger than murrum, hence concrete eliminated the murrum. Concrete will effectively bind the rubble at high load it cannot allow to displace the rubble.

8) Completed open for traffic

Construction steps of lithely arch bridge

Construction Methodology Of Lithely Arch Bridge

- 1. Major Bridge Piers**

- 2. Pre-cast Socket to Rest Arch Strips**

- 3. Socket Placed on Piers**

- 4. Steel Moulds For Casting of Blocks**

- 5. Concrete blocks in line and level**

- 6. Ready For Screed Concrete**

- 7. Wire rope for joining of blocks, only for lifting purpose**

- 8. Screed Concrete**

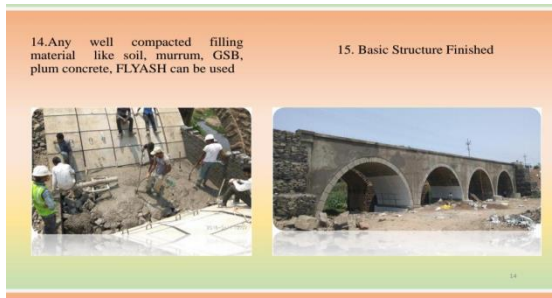
- 9. Arch Strips arrived on site**

- 10. Lifting of Arch strip**

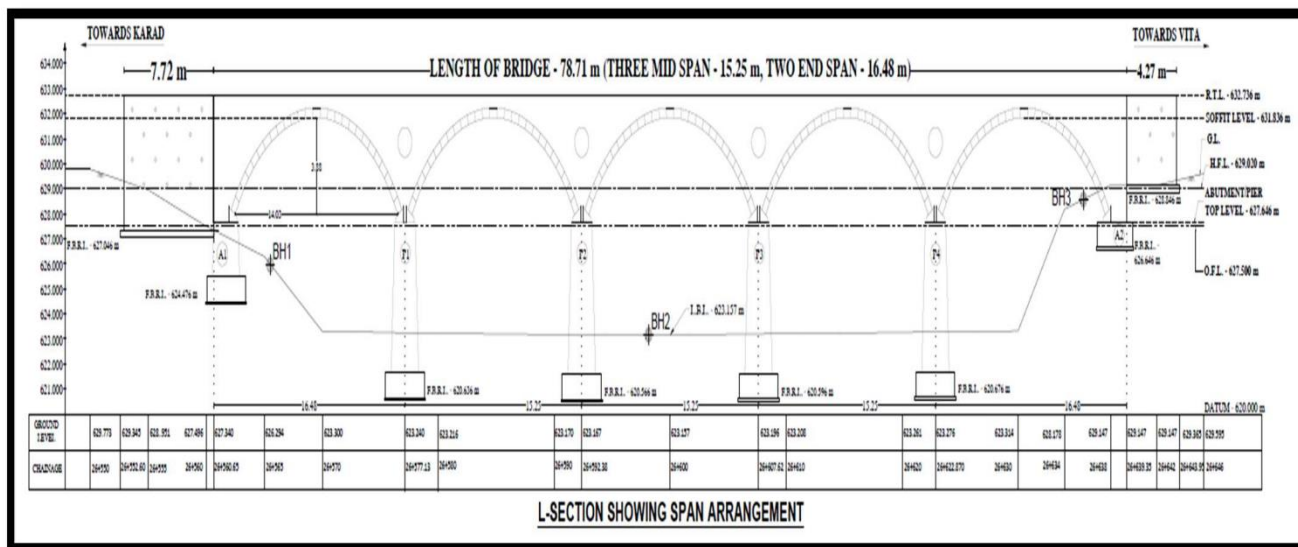
- 11. Placing of Arch strip with the help of crane**


- 12. Arch placed on socket, self-stabilized, no requirement of temporary supports**

- 13. Brick Work as a Spandrel Wall**

General Arrangement Drawing of Open Foundation



General Arrangement Drawing

The “General Arrangement Drawing” gives an overall view of the bridge as it will appear once constructed and it shall include a plan, an elevation, longitudinal section, span arrangement, arch section, a suitable skew diagram and a list of general notes which apply to the entire set of drawings. The general arrangement drawing shall not contain any construction sequence information or any construction requirement information.

Measurement sheet

Measurement Sheet is record of Measurements taken for the selected Item. Measurements help in identifying quantity of Item delivered over a period until the draft Delivery Note is submitted. Measurement shall be

made for finished item of work and description of each item shall include materials, transport, labour, fabrication tools and plant and all types of overheads for finished the work in required shape, size and specification.

Rate Analysis sheet

The process of determining rate of any work in Civil Engineering project like earthwork, concrete work, brickwork, plastering, painting etc. is known as Analysis of Rates or simply Rate Analysis. The rates of these works further help in determining cost of work and in turn cost of the project. It is also defining as to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis. The costs of materials are taken as delivered at site inclusive of the transport local taxes and other charges.

Material Consumption sheet

The material used in the construction have different consumption for each item. Those consumption are given in **SSR**. Each item has its own consumption rate for the different item of work. The consumption of the material decided as per the parentage of the material used in the item of work. **Lead Sheet** The distance between the source of availability of material and construction site is known as “Lead” and is expected in Km. The cost of conveyance of material depends on lead. This statement will give the total cost of materials per unit item. It includes first cost, conveyance loading, unloading stacking, charges etc. The rate shown in the lead statement are for metalled road and include loading and staking charges. The environment lead on the metalled roads are arrived by multiplying by a factor.

- a) For metal tracks – Lead x 1.0
- b) For carts tracks – Lead x 1.1
- c) For Sandy tracks – Lead x 1.4

Abstract Sheet

The estimating and costing means technique of the calculating the various quantities of executed work and then determining their cost known as costing. The costing is mainly done by abstract sheet. This sheet will specify each unit item rate. It also gives the total amount of the item to be required.

Royalty charges sheet

A royalty charge is a payment that a licensee makes to a licensor in exchange for the use of their licensed asset. In construction, this asset could be a new technology, product, system, material or design, perhaps incorporating intellectual property assets like patents, know-how and trademarks.

Future Scope

By lithely arch bridge technology we can minimize the weight of overall bridge, each unit is light weighted and construction procedure is also simple.

Rehabilitation of arch bridges carried out by lithely arch method is more economical than rehabilitation of carried out by replacing bridge with R.C.C beam bridge method.

CONCLUSION

1. Cost effectiveness

Absence of steel improves cost efficiency over conventional bridge solutions. The lithely arch system requires no steel reinforced. As a compression structure, it is self-supporting by virtue of its own weight, without any external support. With the absence of steel rebar content, the possibilities for internal correction, rebar expansion, and the resultant concrete cracking are eliminated. These factors result in a substantially lower carbon footprint and energy consumption during the construction and overall life span of the bridge.

2. Reliability

The lithely arch is based on the same principles of the conventional arch bridge and requires absolutely no maintenance once installed. The bridge is designed to have a service life of over 120 years, almost twice that of modern bridge solutions.

3. Timeless

Rapid installation due to reliance on precast elements.

4. Highway Safe

The lithely arch has designed as per specifications of the MORTH (Ministry of Road Transport Highways) and IRC-6 Loading (70R) with a Load Carrying Capacity of Class 70R and Class AA.

5. Wide Implementation

The lithely arch is suitable for use in Culverts, Minor and Major Bridges, Submersible and High Level Bridges, Animal Crossings, Railway over Bridges and Railway under Bridges.

6. Varying Span

The lithely arch is readily available for spans ranging from 6-15m with ongoing tests for 20m+ spans

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