

# Study and Analysis of Bridges situated in Melghat Region constructed in British Era

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**Abstract** – This paper is all about the “Study and Analysis of Bridges situated in Melghat region constructed in British Era”. The project included the on-site inspection of bridges. These bridges are playing important role in developing not only the Tribal people located in Chikhaldara and Melghat region of Maharashtra but also the Tourism for the Tiger reserve area. Many historical stone masonry arch bridges have been located in various environmental effects. Under these natural or man-made effects such as floods, the bridges were partially damaged. The repair and maintenance of the historical arch bridges is required there. It is very important to know about year of construction of the structures, the sequence of the damages, various repairs and strengthening done in the structure in past and to check about any change in environmental conditions.

**Key Words:** Melghat, Chikhaldara, British Era, Stone Bridges, Strengthening

## 1. INTRODUCTION

Bridge, a structure, is built to cross across a physical obstacles such as a river, valley, railway tracks or roadways. Bridge is the major system in a Transportation. There are number of bridges which are used since British era in India. The development in bridge construction technology is also the related to measure the development of human being.

This study is exclusively for the survey, repair maintenance and strengthening of bridges located in Melghat region which are built in the British era. Most of the bridges are constructed in the year of 1886 as per the information given by regional government body. The following building also constructed in 1886. This marvellous structure is also made up of stone masonry. Such rest houses are built at every approximately 25km interval distance. These all structures are still stand strong enough even after a decade.



The study report comprises the following structural details:-

1. The study is based on different location bridges situated in Melghat region.
2. All the bridges are stone masonry structures.
3. The span length is different for every bridge.
4. The structure consists of stone masonry and brick masonry.
5. The structure probably is decided based upon the availability, economy, and construction suitability of that time.
6. The study and analysis shall be beneficial to the Tribal people of Melghat and tourists for traveling from one point to another point.

Following pages covers the study and analysis existing bridge structures of Melghat. The structure consist of stone masonry arch bridges. This study will definitely not only helps in improving Melghat the road condition but also will helps in developing human development of Tribal people and also the development of tourism for the forest and Tiger reserve of the Melghat.

## 1.1 Objectives

The research objectives are set as follows:

- Active investigation of the site to determine the condition of the bridge and to ensure that adequate measures can be taken for the protection and safeguarding of this historic structure as well as the unique spirit and landmark quality of the entire Cultural-Historical-Environmental Units of Great Importance in Melghat, Maharashtra.
- Enhancing knowledge about the possibility of protecting stone bridges to prevent further degradation, particularly the development of new cracks.
- Enhancing consciousness concerning the values and methods of historical monuments preservation.
- Maintain smooth and uninterrupted transport during any weather conditions.
- Optimize utilization of existing infrastructure and operate at installed capacities to enhance efficiency.
- To study the current situation of British era bridges.
- To analyze its structural stability and workability.
- To check the materials used according to its importance and in terms of availability and strength for further repairs.
- Finding out any vegetation grown and need to be removed as per forest area regulations.
- Minimizing the Natural disturbances need to suffer by the people located there during Monsoon.
- To give suitable suggestions for the improvement of bridges.

## 2. LITERATURE REVIEW

A literature review is a synthesis and critical evaluation of the relevant literature on a particular topic. It is written as a narrative. It provides details about the motivation for the project, why the problem addressed by the dissertation is important, to describe what others have done and hence can set a benchmark for the current study. The review of literature related to the present research is organized and presented as follows.

Even though masonry arch bridges usually follow simple forms, the complexity of their understanding and investigation lies in the variety of ground conditions, geometries of the structure, sensitivity of materials used, weathering conditions and maintenance measures. In

masonry arch bridges, the damages can be followed by various problems that must be thoroughly investigated. For the structure to be restored and its further deformations prevented, the causes of the damages must be analyzed. Masonry arches, as a result of inhomogeneous composition, show complex patterns of failure. Before the loss happens, significant damage with the formation of numerous hinges can occur, which raises the question, of what range of damage is acceptable for the serviceability of the structure.

## 3. METHODOLOGY

Since this research aims to analyze the structural condition of the arch bridges of Melghat, in the following part of the paper, possible causes for this problem will be investigated. For the research shown in this paper, the following methodology is applied: -

- Data analysis using literature review, analysis of previous studies, and the systematization of knowledge about the problem of cracks on arch stone bridges.
- Checklist as per site investigation and observations.
- Observation on the site focused on the built-in materials state, monitoring of supporting elements and the soil/stone beneath the foundation, detection of cracks on the bridge's arch and detection of other damages related to the degradation of the stone structure on the bridge's parapet.
- Discussion regarding previous analysis and developing conclusions about causes of bridge damages and the appearance of cracks.
- Proposition for the strengthening of the arch stone bridge in Melghat based on previous analysis.

### 3.1 PROBLEMS IN ARCH BRIDGES

#### 1) Deficient Load Carrying Capacity:

- Inadequate Fill over Arch Barrel.
- Low Angle of Internal Friction of existing fill material.
- Deficient Structural Design: o Inadequate Span to Rise Ratio, Insufficient Barrel Thickness.
- Flattening of Arch Barrel.
- Transverse cracking at crown and/or Quarter points of the arch span.

#### 2) Ring Separation – In case of Multi-ring Arch Barrel:

- When Travelling Load increases beyond Ultimate Load Carrying Capacity.
- Failure starts in form of separation of ring at intrados level from Arch barrel.

- When separation reaches the threshold limit, complete collapse of bottom-most ring occurs.

- Subsequently, due to thinning of the arch barrel, next ring at intrados level starts separating.

- The above process continues till the arch barrel thickness reduces to an extent where it no longer can safely carry the travelling loads and collapses.

**3) Localised Falling of Voussoirs from Arch Barrel:**

- Due to blockage of weep holes and outlet drainage points.

- Water percolates through the joints between voussoirs in the arch barrel under gravity.

- Over passage of time, the mortar from these joints erodes causing loosening of the voussoirs.

- Loosening of voussoirs leads to localised falling and further reducing the load carrying capacity of arch barrel as a unit.

**4) When Friction between Spandrel Wall and Arch Barrel is not strong:-**

- Wall Sliding
- Spandrel Wall Tilting.
- Spandrel Wall Bulging.

**3.2 STRENGTHENING OF MASONARY ARCH BRIDGE AS PER IRC-40**

**a) Substructure**

- ✓ Scrap clearing
- ✓ Fill cavities wherever required
- ✓ Clear the surface
- ✓ Use wire netting if required
- ✓ Apply coat of mortar

**b) Superstructure**

- ✓ Remove filling above arch portion
- ✓ Cast RCC slab on top (for sound and strong existing approaches) to serve as a supplementary action.
- ✓ If existing is too weak to bare the load then new arch should be made few centimeters above the existing one to fulfill the supplementary purpose.

**3.3 MAINTENANCE AND INSPECTION AS PER IRC-40**

**Life Expectancy**

Superstructure = 70 years  
 Substructure = 100 years

**Types of Inspection**

**a) Detailed Inspection:**

It is the visual inspection of all the substructures and the superstructures.

**b) Routine Inspection:**

It is a physical repair regulatory type inspection. It is applicable to short-span bridges.

**c) In-Depth Inspection:**

Such type of inspection is done once in 3-5 years. This inspection plays a very important role in old bridges.

**3.4 RATING OF EXISTING BRIDGES**

It is especially done for old bridges. Rating of bridge means that the process of accessing the safe load carrying capacity of the bridges. It is affordable safety measure to traffic and public.

Rating of bridge is done using-

- Magnetic Particle Deflectometer
- Radiographic equipment
- Ultrasonic Testing Equipment

**4. PHOTOS TAKEN TO STUDY AND ANALYSE THE CURRENT SITUATION**

**4.1 STONE ARCH BRIDGE (4 SPANS)**



#### 4.2 SUBMERSIBLE BRIDGE (21 SPANS)



#### 4.3 SUBMERSIBLE BRIDGE (5 SPANS)



#### 4.4 SINGLE SPAN WITH GREAT HEIGHT OF 8M.



### 5. CONCLUSIONS

- In this project, it is found out that 95% of the British era bridges of Melghat region are in good condition. Even though all are built almost and before 100 years. Even after a decade they are still standing strong.
- Only found very minor issues like seepage and accumulation of debris, silt etc. But didn't find out any major structural issue.
- The Melghat of Maharashtra is also very known place of India for Tiger Reserve and its beautiful and cold Forest Area. Because of environmental regulations it is very hard to get the permission to clear the vegetation developed on or inside the bridges.

- Such extraordinary design methodology really very appreciable and should also try to implement such marvelous design for future aspects.
- In this, studied the methodology, inspected and analyzed the problems according to IRC codes for Bridge structures.
- This project educated the British construction methodology of the stone masonry structures of an arch bridge.
- This project gives the detailed study of Arch Bridges of stone masonry and the knowledge of Forest regulations laid under roadways.

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