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Preview for the investigation of High-Level Causeway at Naved-Darapur Road.

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Abstract - *Although many factors, including non-technical ones, influence the final location of a stream crossing system, the hydraulics of the proposed location must have a high priority. Hydraulic considerations in selecting the location include floodplain width and roughness, flow distribution and direction, stream type (braided, straight or meandering), stream regime (aggrading, degrading or equilibrium) and stream controls. The hydraulics of a proposed location also affect environmental considerations (e.g., aquatic life, wetlands, sedimentation and stream stability). Finally, the hydraulics of a particular site determine whether certain national objectives, such as the wise use of floodplains, reduction of flooding losses and preservation of wetlands, can be met. The existing Darapur-Naved bridge is very useful only in summer and winter season for the villages neighboring to Darapur which are across the river and could reach to Darapur by other long route of Amaravti-Daryapur highway only or by using the High-Level Causeway bridge. But the bridge is not serving properly during rainy season , the bridge is often over flows ant even it is for two to three days . hence, brought damaged to the bridge. Technically wise, the bridge is deteriorating which is dangerous to the passers. Hence we decided to investigate and inspect the bridge site, the actual condition of the bridge and to detect the defects occurred in the structure. Also, the communities crossing the bridge daily shall interview to detect the problems they are facing to.*

Keywords: *Planning, Inspection, Design, Renovation,Rehabilitation.*

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I. INTRODUCTION

As hydraulic issues remain a leading factor in bridge failures, we recognized that these activities need to include efforts to better collect, understand and deploy more recent and robust guidance and techniques to the accepted state of hydraulic and waterway related practice. This document is one of the products of these efforts.

The analysis and design of a stream channel will usually require an assessment of the existing channel and the potential for problems as a result of the proposed action. The detail of studies necessary should be appropriate for the risk associated with the action and with the environmental sensitivity of the stream. Observation is the best means of identifying potential locations for channel bank erosion and subsequent channel stabilization. Analytical methods for the evaluation of channel stability can be classified as either hydraulic or geomorphic, and it is important to recognize that these analytical tools should only be used to substantiate the erosion potential indicated through observation.

The impacts of bridge design and construction on the economics of highway design, safety to the traveling public, and the natural environment can be significant. An economically viable and safe bridge is one that is properly sized, designed, constructed, and maintained. In general, although longer bridges are more expensive to design and build than shorter bridges, they cause less backwater, experience less scour, and can reduce impacts to the environment. Increased scour from too short a bridge can require deeper foundations and necessitate countermeasures to resist these effects. A properly designed bridge is one that balances the cost of the bridge with concerns of safety to the traveling public, impacts to the environment, and regulatory requirements to not cause harm to those that live or work in the floodplain upstream and downstream of the bridge.

Naved-Darapur High-Level Causeway Bridge was built in 2007-2008, which connects the Communities of Darapur, Naved, Kholapur, Vathoda, Dhangarkheda, Sonarkheda and Bhalsi. The overflow- bridge was constructed between Naved and Darapur across the Purna River to provide service to people going to other town especially the Students from Naved, Kholapur, Vathoda, Dhangarkheda, Sonarkheda and Bhalsi for higher education facilities available at Darapur.

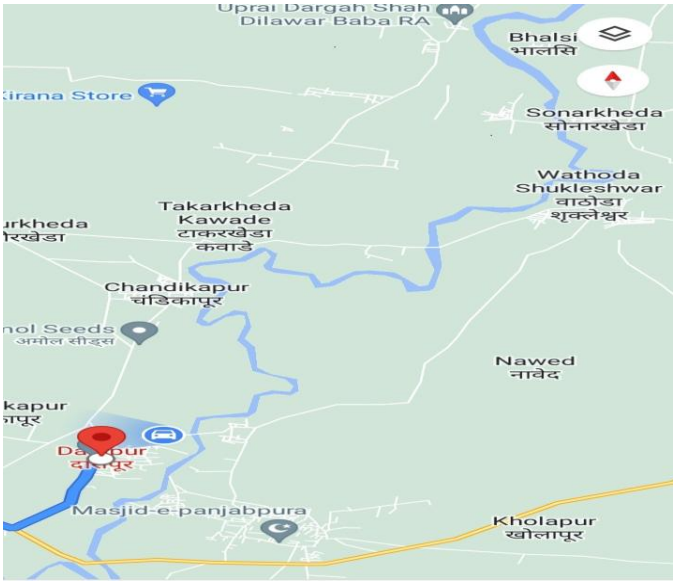

Fig.1 Location of Naved-Darapur road bridge across Purna River

1.1 High Level Causeway

A high level causeway is submersible road bridge designed to be over topped in floods.

Its formation level is fixed in such a way as not to cause interruption to traffic during flood for more than three days at a time nor for more than six time in a year.

Fig.2 High level Causeway

Naved-Darapur bridge has defects due to lack of maintenance procedure and not quite budgeted compared to technology that always maintained and developed. Infrastructure must always develop and maintain to have a good condition and quality. Defect structure must be improved or repaired to give more benefit to the people. Lack of maintenance for bridges can lead to sudden closure of a critical transportation that result in loss of lives and a significant decline in regional economic productivity. Safety of the public is one of the considered aspects in constructing structures. Thus, deficient bridges should have a significant maintenance, rehabilitation or replacement.

Fig. 3 Naved-Darapur River Bridge

Therefore, we decided to survey by statistical method, to examine and detect the defects of the existing bridge by actual inspection and investigation on bridge site and to suggest the renovation required for the efficiency of bridge and for comfort, convenience and safety of the communities crossing the bridge.

II. RELATED LITERATURE REVIEWS

The purpose of HDS 7, Hydraulic Design of Safe Bridges, is to provide technical information and guidance on the hydraulic design of bridges. HDS 7 replaces the HDS 1 manual "Hydraulics of Bridge Waterways" (FHWA 1978) for guidance of bridge hydraulic analyses. Bridges should be designed as safely as possible while optimizing costs and limiting impacts to property and the environment. Many significant aspects of bridge hydraulic design are discussed. These include regulatory topics , specific approaches for bridge hydraulic modeling, hydraulic model selection, bridge design impacts on scour and stream instability, and sediment transport.

Determining the hydraulic capacity of bridges and culverts is a field that has been evolving in the United States since the mid 1800s. The earliest methods of sizing hydraulic openings were largely based on experience and historic performance. However, as the railroads expanded westward many crossings were encountered where there was no flood history or other up or downstream structures to use as the basis for determining bridge or culvert size. Therefore, tabular and empirical methods were developed that related waterway opening to size of drainage area and other coefficients that accounted for drainage basin and stream characteristics. The American Railroad Engineering and Maintenance-of-Way Association (AREMA) published a report in 1911 that presented six formulas for waterway area and 21 formulas for design discharge. A report by V.T. Chow in 1962 listed 12 formulas for waterway area and 62 formulas for design discharge (McEnroe 2007).

The nation's infrastructure of highway bridges is plagued with two major problems: premature deterioration and structural deficiency, both of which were underscored as strategic research issues in a recent NSF study (“Civil” 1998). At the national level, over 28% of all bridges are classified as structurally deficient or functionally obsolete (“The Status” 1999). Even newer bridges have shown a growing rate of premature decay. A major effort is now underway to rebuild the nation's civil infrastructure. In order to simply maintain the current conditions of highway bridges (with no improvement), an average annual cost of $5.2 billion is needed through the year 2011 (“The Status” 1999) for rehabilitation and replacement of existing bridges. Hence, it is vital to the U.S. economy that cost-effective structural systems and materials be explored in order to extend service life and to improve performance of highway transportation infrastructure facilities.

The earliest methods for determining waterway openings for bridges and culverts did not consider bridge or culvert configuration. Furthermore, the concept of a "design" discharge or recurrence interval of expected floods to use when determining structure size was not considered. Even though design discharges were not considered an early textbook on highway design and construction by Byrne (1893) suggested that the factors to be considered when determining the capacity of a hydraulic culvert depended on; (1) the rate of rainfall, (2) the kind and condition of the soil, (3) the character and inclination of the surface, (4) the condition of inclination of the bed of the stream, (5) the shape of the area to be drained, and the branches of the stream, (6) the form of the mouth and the inclination of the bed of the culvert, and (7) whether it is permissible to back the water up above the culvert, thereby causing it to discharge under a head. These same concepts were applied to the hydraulic sizing of bridges. As techniques for estimating discharge developed throughout the 1900s these same factors translated into many of the parameters found in methods used today to estimate recurrence intervals, peak discharges, and hydrographs.

III. METHODOLOGY

The descriptive research method, engineering survey, and inspection shall be used in the study. The normative survey of descriptive research shall use in relation to the stakeholders' perceptions on the assessment of the existing over-flow bridge. Normative survey establishes norms for abilities, performances, beliefs and attitudes on samples of people of different ages, gender and other classifications. Use of the purposive sampling which samples were those who are aware of the existing over-flow bridge and are free to answer questionnaires relative to the condition and effect of the said facility. Engineering survey and inspection of the facility shall be conducted to further investigate and assess its condition.

3.1 Respondents for the Study

It is decided to interview 150 respondents for the study shall be composed of the communities from Naved, Kholapur, Vathoda, Dhangarkheda, Sonarkheda and Bhalsi crossing the Naved-Darapur Road bridge.

3.2 Instruments shall be used

By preparing the questionnaires for respondents' perception relative to the condition and effect of the existing over-flow bridge were used in the study. Also, the researcher should use other engineering instruments during the inspection in order to investigate the physical features of the structure.

Also, the Bridge inspections should undertake at bridge site and for the entire structure. Visual inspection should undertake on the bridge superstructure over and under the bridge checking all the critical structural members. Measurements shall undertake for members that are damaged and affected by the flood.

3.3 The use of Statistical Method

Statistics is basically a science that involves data collection, data interpretation and finally, data validation. Statistical data analysis is a procedure of performing various statistical operations. It is a kind of quantitative research, which seeks to quantify the data, and typically, applies some form of statistical analysis. Quantitative data basically involves descriptive data, such as survey data and observational data.

3.3.1 Collection of the Data

Data in statistical data analysis consists of variable(s). Sometimes the data is invariant or multivariate. Depending upon the number of variables, the researcher performs different statistical techniques.
The data in statistical data analysis is basically of 2 types, namely, continuous data and discreet data. The continuous data is the one that cannot be counted. For example, intensity of a light can be measured but cannot be counted. The discreet data is the one that can be counted. For example, the number of bulbs can be counted.

3.3.2 Analysis of the Data

There is a major task in statistical data analysis, which comprises of statistical inference. The statistical inference is mainly comprised of two parts: estimation and tests of hypothesis.
Estimation in statistical data analysis mainly involves parametric data—the data that consists of parameters. On the other hand, tests of hypothesis in statistical data analysis mainly involve non parametric data the data that consists of no parameters.

After gathering and collecting the data, organized and analyzed information by using tabulation and bar graph.
Weighted Mean.

The formula to compute the weighted mean is,

$$\bar{X} = \frac{\sum Fx}{N}$$

Where: $\bar{X}$ = Weighted Mean
$\sum Fx$ = Summation of the elements and its weight.
N = Number of respondents.
Below is the rating scale used in the study,
4.50 – 5.00 = Very Satisfied
3.50 – 4.49 = Satisfied
2.50 – 3.49 = Neutral
1.50 – 2.49 = Unsatisfied

1.00 – 1.49 = Very Unsatisfied

3.3.3 Data collection from respective PWD office of the existing bridge:

1) Hydraulic Data
2) Geological Data
3) Construction Details of the Bridge.

IV. RESULTS

It is found that during flood the water level is about 1.7 m above the bridge deck is observed . Hence the Bridge is not serving the uninterrupted service for the communities crossing the bridge. During flood people used to another route which is Amaravti-Daryapur highway is costly as well as time consuming.

Therefore people and specially students and the patients needed for medical emergency used to prefer Naved-Darapur Bridge than that of Amaravti-Daryapur highway. It is observed during the monsoon that the bridge overflows continuous for three to four days. Hence the traffic interrupted for four to five days due to silt deposited over the bridge. It is observed that June 2021 to September 2021the bridge overflowed for nine times and in the year 2022 it overflowed for 12 times.

Fig. 4 Water Level During Flooding

V. CONCLUSION

- The Naved-Darapur road bridge was designed as High-Level causeway and according to the ideal requirements of High-Level causeway the bridge is deficient in its structural design.
- But according to the locality if they are satisfied with the overall bridge condition or not is to annalise by statistical method of analysis adopted.
- The existing high level causeway can be completely eliminated due to adverse flood condition, rapid development of population and industrialization and unavailability of facilities and basic standard provisions.

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