Review on Behavior of Foot Over Bridge

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Abstract **- The Bridge is a structure that provides a passage over a gap or obstacle like a roadway, tunnel, river, etc. Construction of bridges is always challenging for the civil engineer. The different types of bridges play a different role according to their types and material. The pedestrian bridge is one of the popular bridges which is used to eliminate the delay and congestion in traffic on the highway. Similarly, the foot over bridge is used to eliminate the conflicts between vehicles or railway. The foot over the bridge can be made of any combination of material namely concrete, steel or composites. Now-days it is observed that use steel foot over bridges is more because it gives safe, efficient and economical results with speedy construction. The objective of this paper is to present the detailed concept and working principle of various configurations of the foot over bridges and the current trends in implementation of the foot over the bridge for pedestrian or cyclist. In addition to these various problems associated with the foot over the bridge are also discussed. A detailed investigation of literature available in the field of the foot over bridges carried out and the summary and gaps encountered in the study are listed in this paper.**

keywords **- foot over bridge, steel materials, timber, truss types.**

I. INTRODUCTION

A. General

The bridge is a structure that provides passage over obstacles such as valleys, rough terrain by crossing those obstacles with artificial materials. They first began being used in ancient times when first modern civilizations started rising in Mesopotamia. From that point on, knowledge, engineering, and manufacture of new bridge-building materials spread beyond their borders, enabling slow but steady adoption of bridges all across the world.

A foot over bridge is a bridge designed for the pedestrian. The bridge is a structure that links "two distinct areas at a height above the earth". The easy type of bridge is steppingstones, so this may have been one of the premature types of a footbridge. Foot overbridges are used to change platform at a railway station, skywalk in metro cities. Different types of design foot over bridges include timber foot over bridges, steel foot over bridges, and concrete foot over bridges. The steel truss is generally used for the construction of foot over bridges of different sizes. It is a useful material that provides provable solutions. Steel has long been recognized as the economic option for a range of foot over bridges. Steel foot overbridges are used because easy to assemble, less cost, low maintenance, flexibility in design.

Foot overbridges have different designs, here are some of them:

1. Simple suspension Bridge:

A "simple suspension bridge" is supported by anchors at ends. Its cables are free-hanging while holding deck they follow a hyperbolic curve. This type of design is considered in developing countries.

Fig.1. Simple Suspension Bridge.

2. Clapper Bridge:

"Clapper Bridge" was built across the rivers. This type of bridge consists of flat slab schist and it's supported on stone piers. Clapper bridge name comes from the Anglo-Saxon word 'cleaca'.The meaning of 'cleaca' is "bridging the stepping stones"

Fig.2. Clapper Bridge.

3. Stepping stones bridge:

A "stepping stones" bridge is the oldest type of bridge. This type of bridge is consists of a slab of rock placed on supported stone piers so the river can be crossed without getting wet by stepping on stones.

Fig.3.Stepping Stones Bridge.

D. Applications of Foot Over Bridge

1. The foot over bridge at the railway station to change platform.
2. The foot over bridge used over busy streets to cross the road.
3. The foot overbridges are used for skywalks in metro cities.
4. The foot overbridges are used for providing passage to intake well from the bank of the river.
5. The foot over bridge used for connecting two building towers at a higher level.
6. The foot over bridges used to cross stream of moderate width.

II. LITERATURE REVIEW

In this section, the present theories and practices related to the behavior of foot over the bridge are studied by referring to published literature in various journals, books and conferences from India and abroad. Following a review of Literature gives an outlook on the behavior of foot over bridge.

V. Chandrikka et al. (2019) have investigated the performance of the Analysis and design of cold-formed steel foot over bridge at kondalampaaty bye-pass, salem. The main purpose of this paper is to design a harmless, economical and simple to assemble foot over bridges for walkers. In this paper analysis of cold-formed steel box section using STAAD Pro. Software. The thickness of the steel sheet is 2 to 3 mm and yield strength of the steel sheet is 280 N/mm^2 . The cold-formed steel box section of the foot over bridge is constructed because of bending operation simple and low cost. Design of cold-formed steel box-section columns and beams are used EUROCODES EN 1993 and done manually. The authors conclude that the cold-formed box section will reduce the dead weight of the structure and provides high strength and durability.

M. Limje et al. (2019) examined the detailed Appraisal and Design of Foot over Bridge. The main purpose of this paper is to analysis and design of foot over the bridge between the stretch surat railway station and surat bus station with high hourly volume traffic. In this paper analysis of foot over bridge using STAAD Pro. In this paper Foot over bridges specially design for pedestrians and cyclists. The total length of the foot over bridge is 171m and the height of the foot over bridge is 12m and the width of the foot over bridge is 4m. The design of foot over the bridge has done by using IS 800:2007. The main purpose of this paper is to design economical and provided economical sections. The foot over bridges design considering future changes and loading.

R. Wakte et al. (2019) have worked on Comparative Seismic Analysis of Steel Foot Bridge for Human Resource Safety. Steel is generally used materials for footbridges construction in the world. The strength, durability and high ductility of steel are appearances that are perfect for seismic design. In this paper analysis for various load cases that are for load case-I, II, III, considering Dead Load, Live Load & Earthquake Load whereas in load case-I the footbridge is analyzed for Dead Load and Live Load only, while other remaining load cases are analyzed including Earthquake Load also. In this paper bridge is located in the zone- IV and used IS 1893-2002 and IS 800-2007. In this paper, the seismic coefficient method and response spectrum method are used. The aim of this paper is to compare the results of static and dynamic analysis thoroughly. This paper concluded that positive results of static analysis are high as compared to dynamic analysis. This paper indicates that the static method is safe but the uneconomical and dynamic method will be stable as well as economical.

B. Herbudiman (March 2017) has carried out their research work on the Design of pedestrian truss bridge with Sengon-Rubber laminated veneer lumber. The wood material is used to make light vehicles or foot over bridges. Timber type bridges design for a medium span of the bridge. The applications of this type of bridge are low cost, lightweight and have aesthetic value. Timber supply decreases so its alternative laminated veneer lumber consists of thin layers that glued together with sengon wood (density of 0.35 kg/m3) and rubberwood (density of 0.61 kg/m3) as base materials. The design of timber foot over bridge consists of pedestrian and light vehicle. Structural analysis using SAP2000. In this paper, the Response spectrum method is used. The main benefit of this research is to make laminated veneer lumber as an alternative material for foot over bridge.

D. Bacinsksa et al. (2017) have worked on the Structural analysis of the GRFP truss bridge model. An experimental study of the structural behavior of glass fiber reinforced polymer (GFRP) foot over the truss bridge model using static loading is discussed in this paper. The bridge was assembled using steel bolts, brackets, glass fiber reinforced polymer. The length of the structure is 6m, width 0.75m, height 0.53m. The bridge was constructed in a research laboratory at Vilnius Gediminas technical university. The bottom chord of the bridge with four bearing pads.to measure the deflection of the bottom chord of the structure used by linear variable displacement transducers. The uniformly distributed load applied using steel bricks 20-30 kg on wooden deck panel. The behavior Numerical model of the foot over bridge using Solid works software. The obtained results show that tested and designed glass fiber reinforced polymer foot over the truss bridge model has a structural rigidity. The authors concluded that Glass Fiber Reinforced Polymer is suitable for foot over bridge Structures.

S. Rajesh (2017) has carried out research work on the Design of steel foot over bridge at the railway station. The site was chosen for foot over bridge at the Chennai railway station. The total length of the foot over the bridge span is 28m over 3 track. As per the Indian railway code width of the gangway taken 3m. The foot over bridge various components like the main truss, column, footings analyzed by STAAD Pro. Structural software. The use of steel material is compared to a reinforced concrete structure in the overall economy. The design of the column, bracing, top cord, bottom cord members according to IS 800:2007. The design of footing according to IS 456:2000. The main purpose to design lightweight foot over bridge with safe and economical, maximum strength. The authors concluded that the foot over bridge components are design for maximum safety and adopted economical sections.

S. Gupta et al. (2017) have worked on Comparative analysis of different truss type railway steel bridges considering railway loadings**.** In this paper study analysis and design of steel truss railway foot over bridge of span 50m. In this paper railway bridge 50m with railway loading, 32.5 tons has assigned in different types of truss-like Pratt truss, Howe type truss, warren type truss, and k-type truss Sections and find out stable and optimized sections. The design and analysis using STAAD Pro. The design of structural all members of steel truss railway foot over bridge is done in accordance with Indian railway standard and Indian road congress code. In this paper results of shear force for warren type truss is more as compare to Pratt, Howe, and k-type truss but axial force results of Pratt truss are more as compare to others. The results of deflection are maximum in Howe truss bridge whereas minimum in warren steel truss bridge which indicates Howe truss bridge requires more supports as compare Pratt, warren and k-type truss bridge. The result of steel structure weight for warren type truss steel structure is more costly than others whereas the Howe truss structure is more economical than others. The authors concluded that Howe type truss bridge shows minimum values, Howe truss bridge takes less weight of construction material which makes it more economical than others.

V. A. Saluja et al. (2016) have carried out research work on the Seismic Analysis of Foot over Bridge for Different Soil Conditions. Modeling and seismic analysis of foot over the bridge for a different span of FOB. The analysis and design of foot over the bridge by using STAAD Pro. Structural software. The effective span of the foot over bridge is taken 20m and 30m span. The structural analysis is to determine stress, deformations, and forces of different load effects. The main purpose of this paper is to check the seismic effects of the foot over bridge of different soil conditions in a different earthquake zone. In this paper seismic analysis of foot over the bridge by using the response spectrum method for different soil conditions in different

earthquake zones. The authors concluded that the moment and reactions increasing at nodes with different soil conditions with different earthquake zones.

A. Kulkarni et al. (2015) has a study on material properties for the foot over bridges to improve the durability and strength. Last three decades various types of good quality materials are introduces in the market. It is proven that good quality material increases the strength of the bridge. For this article prime focus is to provide good quality of material and cost-efficient bridge structure with no compromise with main structural properties. The author considers two types of bridges such as steel foot over and cable foot over for the case study. For the analysis of these two bridges, STADD pro software is used. The design loads are taken as per IS 800:2007 code and all loads conditions are safely carried by the bridges but by comparison of the design and drawing it is concluded that the cable foot over bridge is more durable and economical as compare to steel foot over bridge.

R. and Kaushik Kumar et al. (2014) has a study of the design and optimization of a portable footbridge. The portable footbridge is most convenient to install and dismantle as compare to another conventional type of bridge. The prime focus of this paper is to minimize the total deformation of the structural member by improving the cross-section, material properties and structural weight. The author considers the six different shapes such as circular, rectangular and square with a solid and hollow section of the beam and three different materials namely structural steel, titanium alloy and aluminum alloy for the experiment. The whole modeling is done by using SolidWorks. For the analysis, finite elements software ANSYS is used with loading and support conditions are the same for all models. The analysis is done in three phases namely pre-processing, solution and post-processing by using FEA software ANSYS. It concludes that by analysis and comparison of six different shapes and three different materials in ANSYS software. The rectangular hollow aluminum alloy section is considered for the portable footbridge. Because the aluminum alloy is much lighter and cheaper than other materials.

III. Summary of Literature

1. The researchers concluded that cold-formed box sections will reduce the dead weight of the structure and provides high strength and durability.
2. The researchers concluded that the analysis of foot over bridge using railway loading for Howe truss bridge is more economical than k-type truss, Pratt type truss, and warren truss.
3. The analysis and design of foot over the bridge by using STAAD Pro. Software and adopted economical sections.
4. The researchers concluded that the glass fiber reinforced polymer is suitable for foot over bridge structure.

IV. Gaps in Literature

Based on the literature review investigated with reference to the behavior of foot over bridge, there is a certain absence of research work which is not studied earlier, as mentioned below:

1. Comparative study of seismic analysis of different types of foot over the bridge for different span in different earthquake zones.
2. Analysis and design of foot over the bridge by using ETABS software.
3. Analysis and design of foot over the bridge by changing bay spacing by different span with channel sections using by STAAD Pro. Software.

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