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DESIGN AND SHAPE OPTIMIZATION OF FOOTOVER BRIDGE

[1]Aditya Gaikwad, [2]Sanket Saste, [3]Samarth Waghmare, [4] Mr. K.H. Ghorpade

[1-3] Student, Civil Engineering, Trinity Academy of Engineering, Pune, India

[4]Assistant Professor, Civil Engineering, Trinity Academy of Engineering, Pune, India

Abstract: This project revolves around the conceptualization, examination, and optimization of a pedestrian bridge. The focus here is on designing an overhead pedestrian bridge in locations where traffic volume surpasses 1500 vehicles or where a significant number of accidents occur. The primary objective is to alleviate conflicts between pedestrians and motor vehicles.

In areas such as those in front of schools, colleges, offices, and other public spaces where pedestrians, particularly students, frequently traverse the road, the hourly traffic exceeds 1500 vehicles on average. Navigating these busy roadways by foot not only poses a challenge but also carries inherent risks. With this context in mind, the project aims to create an aesthetically pleasing pedestrian bridge at key intersections in front of areas with high pedestrian footfall. This initiative intends to relieve traffic congestion and minimize delays on the highway, while also enhancing safety by mitigating conflicts between pedestrians and motor vehicles.

Keywords: **- design, accidents, analysis, shape optimization, pedestrian bridge, pedestrian safety, high traffic volume.**

INTRODUCTION

Foot overpasses are incorporated into road and rail transport infrastructure to facilitate the uninterrupted movement of pedestrians and cyclists, keeping them separate from vehicular traffic. Nevertheless, building and maintaining these elevated crossings can be prohibitively expensive and, at times, impractical due to the presence of other integrated transportation systems nearby. In such cases, an alternative approach is often proposed, involving the implementation of traffic-calming measures, such as pedestrian-activated signals accessible to all pedestrians.

The use of pedestrian-activated signals, however, may not be suitable in scenarios with a high pedestrian count, as this can slow down vehicle traffic on connected highways, particularly those vital for the main city's traffic flow. Installing closely spaced traffic signals is also problematic. Therefore, it becomes crucial to assess the feasibility of pedestrian foot overpasses to ensure the safe and efficient movement of both pedestrians and vehicles. Pedestrian overpasses above highways or railroads can significantly escalate in cost, especially when elevators or extended ramps for wheelchair users are necessary. Hence, it can be argued that overpasses should only be considered when the number of users justifies the associated expenses.

Moreover, the decision to prioritize pedestrian foot overpasses over other solutions should also consider the long-term benefits they offer beyond immediate traffic management concerns. Foot overpasses not only enhance pedestrian safety but also contribute to urban development by fostering walkability, reducing carbon emissions, and promoting healthier lifestyles. By providing dedicated pathways for pedestrians and cyclists, foot overpasses encourage alternative modes of transportation, thereby mitigating the environmental impact of

vehicular traffic and alleviating strain on existing road infrastructure. Additionally, the aesthetic and functional improvements associated with well-designed foot overpasses can enhance the overall urban landscape, creating vibrant public spaces and fostering a sense of community pride. Thus, while the initial investment in pedestrian foot overpasses may be substantial, the potential socioeconomic and environmental benefits they yield make them a valuable asset in sustainable urban planning initiatives.

PROBLEM STATEMENT

This initiative focuses on enhancing the design and form of a pedestrian overpass. The location in question experiences a confluence of pedestrian and vehicular traffic, leading to potential conflicts. Our investigation encompasses a specific area spanning Pune City, characterized by a notable volume of hourly traffic. Negotiating this stretch on foot is not only demanding but also poses significant safety hazards. To address these pressing issues, our project attempt to assess the viability and formulate a design proposal for a pedestrian overpass along this corridor. The intended outcome is to reduce traffic congestion, mitigate delays, minimize conflicts between pedestrians and vehicles, and enhance overall safety by preventing accidents

LITERATURE REVIEW

1) A Proposal of Foot Over Bridge at Congested Intersection

In order to enhance the role of Non-Motorized Transportation (NMT), it is crucial to ensure that travelers feel safe and at ease during their journeys. This can be achieved through the establishment of well-planned and developed infrastructure. An examination of the current situation reveals that the level of service at variety square during peak hours is rated as 'E,' and this rating is progressively deteriorating over time. Several significant landmarks have been established in the vicinity, including the Eternity Mall, Sita Bardi Street (home to local vendors And shops), the Bardi Bus Terminal (which witnesses a daily movement of 23,000 passengers), The City Bus-Stop, Zero Mile Metro Station, and the ongoing construction of Global Square.[1]

2) Design of Lightweight Footbridges for Human Induced Vibrations

The document highlights the critical consideration of human-induced vibrations in ensuring the structural safety and user comfort of footbridges. It addresses the need for pedestrian-induced vibrations to stay within acceptable limits, preventing the lock-in phenomenon, and ensuring structural safety under intentional excitations. Recognizing a gap in lightweight footbridge design procedures, the proposal introduces a comprehensive guideline. The methodology covers dynamic property evaluation, response measurements, and identification tests. The document also reviews strategies to control footbridge vibration responses. Three practical examples, including a simply supported beam and two existing footbridges, illustrate the application of the proposed design methodology.[2]

3) Design and analysis of pedestrian bridge

This project involves the conceptualization and analysis of a pedestrian bridge. Specifically, the focus is on designing an overhead pedestrian bridge to address the issue of conflicts between pedestrians and motor vehicles in an area with a traffic volume exceeding 2500 vehicles. The location, in front of Aurora's Engineering College, experiences high traffic, making pedestrian crossings not only challenging but also hazardous. To mitigate these challenges and enhance safety, the project aims to construct a pedestrian bridge at the road intersection near the college building. The objective is to alleviate traffic congestion, reduce delays on the highway, and eliminate conflicts between pedestrians and vehicles. The design process utilizes the software tool STAAD.Pro. [3]

4) A review study of pedestrian bridge truss structure for low-traffic volume

This study emphasizes the valuable insights gained from examining truss structures. The research focused on the assessment and construction of stainless-steel bridges using locally sourced steel profiles. The findings suggest that building steel bridges with local materials is available option, supported by the research and design work conducted. While the cost of local production is comparable to importing materials, it remains a

favorable choice due to its potential to enhance the capabilities of local design, manufacturing, and construction companies. This approach also contributes to job creation and cost savings. Furthermore, locally constructed steel bridges can serve as temporary solutions in various road construction projects, particularly in challenging locations, and they can be erected relatively quickly.[4]

5) Review on Behaviour of Foot Over Bridge

The study's findings suggest that utilizing cold-formed box sections in construction can effectively decrease the overall weight of the structure while simultaneously enhancing its strength and durability. According to the research, when assessing foot over bridge designs under railway loading conditions, the howe truss bridge outperforms the k-type truss, Pratt type truss, and warren truss in terms of cost-effectiveness. The investigation involved the use of STAAD Pro software for the analysis and design of a pedestrian bridge, focusing on selecting sections that offer the best cost-efficiency. The research team's results indicate that glass fiber reinforced polymer is a suitable material for constructing pedestrian bridges, given its favorable characteristics for this application.[5]

6) Vibration serviceability of footbridges under human-induced excitation

The growing strength of new structural materials and longer spans in footbridge design, coupled with aesthetic demands for slenderness, has led to more dynamic structures. Public attention intensified after the Millennium Bridge in London exhibited excessive lateral sway due to crowd-induced vibrations, highlighting a vibration serviceability concern for footbridges. This paper provides the most extensive review to date, encompassing around 200 References on the characterization of vibration sources, paths, and receivers. Humans are identified as the primary vibration source, but modelling crowd-induced dynamic forces remains unclear. Damping, among the mass and stiffness of the footbridge, is crucial and uncertain, influencing vibration serviceability. Pedestrians, often both the source and receiver, challenge existing scales for rating human perception of vibrations. The interaction between walking people and footbridge vibration properties is not well understood, and comprehensive design guidance is lacking. The paper underscores the need for an update in design codes to reflect recent research achievements, presenting a significant challenge for the Next 5–10 years. [6]

7) The Role and Importance of a Footbridge Suspended over a Highway in the Opinion of Its Users-Trabzon (Turkey)

The study in Trabzon focuses on the usage patterns, safety concerns, and motivations of people of different ages utilizing an overpass connecting the northern part of the city with parking lots and seaside boulevards. The research, involving 124 participants, indicates that while safety is a primary reason for choosing the overpass, frequent users tend to recognize additional functional aspects. Surprisingly, despite its location over the black sea coastal highway, the overpass is primarily used for descending to the coast, with a significant portion of respondents reporting infrequent use.[7]

8) Analysis and design of a steel foot over bridge with tubular section using STADD.Pro

This paper discusses the process of designing a foot over bridge using specific parameters like specifications, loadings, and material properties. The design was analyzed and optimized using STADD.Pro v8i software and it passed the structural assessment, ensuring its safety and cost-effectiveness. The analysis provided important results, including maximum shear force, bending moment, and stress values. These values are crucial for ensuring that the bridge can withstand the Intended loads and remain structurally stable.[8]

Additionally, they mention that a detailed estimation of the amount of steel used in the structure has been provided. This estimation includes information about the different types of steel sections used and their

respective weights. This information is essential for both construction planning and cost estimation, ensuring that the project is both safe and economically viable.

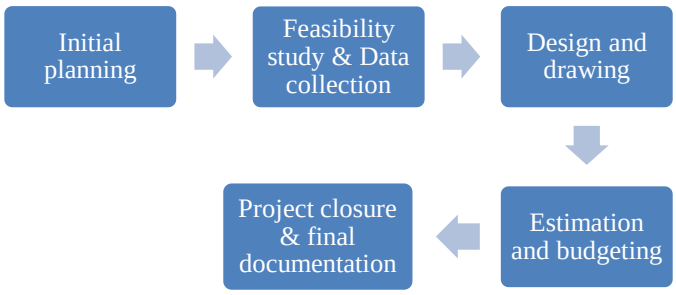
9) Analysis and Design of Foot-Over Bridge

Designing and constructing foot over bridges is a critical aspect of modern construction, and it involves various structural components and considerations to ensure safety, efficiency, and cost-effectiveness. The assignment's primary goal is to explore the utilization of STAAD Pro for the evaluation and construction of a truss, emphasizing the importance of efficient structural engineering in today's competitive industry. The process involves manual load estimates and STAAD Pro analysis, considering factors such As the structure's own weight, dead and live loads, and wind pressure. Compliance with IS 875 requirements is ensured through STAAD Pro's calculation of wind loads at various heights. The Analysis employs different sizes and shapes of steel elements, employing a trial-and-error approach to achieve optimal results. The overarching aim is to guarantee the structural integrity of planned buildings by strictly adhering to minimum design loads specified in the code.[9]

10) Design and analysis of foot over bride using STADDPRO

Footbridges are essential in areas where a designated pathway is needed to guide pedestrian traffic or overcome physical obstacles, such as rivers. While the loads they bear are comparatively modest compared to highway or railway bridges, the requirement for a lengthy clear span often necessitates a structurally stiff design. Visibility to the public makes the aesthetic aspect crucial, and steel emerges as an economically viable and aesthetically pleasing material for footbridge construction. Unfortunately, many existing footbridges in seismic zones are inadequately equipped to withstand earthquakes due to rapid construction. As traffic increases within limited spaces, footbridge lengths tend to be medium to large. To address seismic vulnerability, this project focuses on designing an optimal footbridge, including connection details and structural component estimation, along with foundation detailing for the footbridge structure. [10]

FLOW CHART:



Various type of Foot over bridges in Pune city:

Fig No 1: - FOB at Bhosari

Fig No 2: - FOB at Chinchwad

Fig No 3: - FOB at Vishrantwadi

CONCLUSION

It becomes evident that civil engineering research has made significant steps in advancing the principles of structural integrity, aesthetics, cost-effectiveness, and pedestrian safety in infrastructure projects. Through a detailed examination of existing studies and case reports, this review highlights the importance of leveraging advanced computational tools and engineering principles to optimize foot over bridge designs. The literature underlines the critical role of repeated refinement and interdisciplinary collaboration in achieving optimal solutions that meet the diverse needs of communities while prioritizing pedestrian safety. This review not only consolidates existing knowledge but also identifies gaps in research and opportunities for future investigation, paving the way for further advancements in the field of civil engineering.

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