SENSITIVITY STUDY OF ARCH AND CABLE STAYED PEDESTRIAN BRIDGES

N.N.PAULUSZ
199209E

M.Sc.IN STRUCTURAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

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NATALIE NADEESHA PAULUSZ
199209E

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Declaration

I declare that this is my own work, and this dissertation does not incorporate without acknowledgment any material previously submitted for a degree or diploma at any other university or institute of higher learning, and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the master's dissertation under my supervision.

Name of the Supervisor: Dr. K. Baskaran

Signature of the Supervisor: Date:

Abstract

The configuration of pedestrian bridges varies from project to project due to project requirements. However, no single structural form can be employed for every configuration of pedestrian bridge because different structural forms have varying degrees of effectiveness. Because the functional requirements for pedestrian bridges are less constrained, designers are free to develop unique solutions that cater for potential unanticipated problems. By carefully analyzing multiple design options and engineering principles, construction professionals and civil engineers can select the optimal structural form that meets project objectives, maximizes structural efficiency, and ensures the long-term safety and durability of the built environment. Regretfully, there is still a lack of adequate instruction in these skills in engineering programs; certain small and medium-sized bridges serve as examples of this. Structural design sensitivity analysis focuses on the relationship between the design variables that the engineer can manipulate and the structural reaction that is determined by the laws of mechanics. Using this method will help you narrow down the possibilities to the ideal design solution. The research focused on several geometries and examined how different geometric requirements support structural performances in different forms, starting with alterations to a pedestrian bridge. The study's objective was to assess two possibilities and make recommendations for how they might be used to different geometric requirements. A review of the literature was done to learn more about the various types of footbridges, their functions in daily life, their significance, the evolution of bridge structures, and the components that made them up, with an emphasis on both architectural and engineering viewpoints. found footbridges with structural forms that have been studied in literature in various locations, took pictures of them, looked at geometry fundamentals, investigated the mechanism of load transmission, observed the structural details of the structures, and chose for analysis bridges with two different structural forms arch and cable stayed bridges that are believed to adhere to the social and architectural values discussed in the literature. Following an observation of the existing footbridges, a new instance was formed, design rules were developed, and two structurally similar alternatives an arch and a cable stayed bridge were presented. The modifications were made to a select few existing footbridges in compliance with the project requirements. Modified the geometry of both options by half to twice the original width, height, and span while keeping the same other measurements. After that, computer structural models were created for every scenario. By contrasting the two possibilities based on how sensitively the structural performance responds to changes in geometry, it was possible to determine the adaptability of each structural form to different geometric requirements in a project. The sensitivity analysis's findings indicate that the design changes will primarily address the arch bridge's rise to span ratio. In the short-to-medium span range, the 1:12 height-to-span ratio acts as a threshold to regulate the structure's susceptibility to geometric alterations. This indicates that if the arch bridge's rise to span ratio varies by a factor less than 1, the structure may be operating with a sizable safety margin. The analysis indicated that shallow-medium spanned arches would be efficient. In a cable-stayed bridge, the irregularity of the shape resulting from a change in geometry is evident, in contrast to arch bridges. Therefore, when constructing a cable-stayed bridge, proper proportions must be considered in addition to achieving the maximum level of structural performance. Nonetheless, it is clear that performance of the cable-stayed bridge's structure is not fully realized in the short to medium span range.

Keywords: Pedestrian Bridge, Sensitivity Analysis, Bridge Form, Structural Efficiency

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BC - Before Christ
AD - Anno Domini
3D - Three Dimensional
DL - Dead Load
LL - Live Load
WL - Wind Load
FEM - Finite Element Model
BM - Bending Moment
AF - Axial Force

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