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STABILITY ANALYSIS OF STEEL FOOT BRIDGE FOR HUMAN RESOURCE SAFETY

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Abstract: The perception of cloud computing has not only reshaped the field of distributed systems but also fundamentally changed how businesses utilize computing today. Cloud computing is offering utility oriented IT services to users worldwide. It enables hosting of applications from consumer, scientific and business domains based on pay-asyou-go model. However data centres hosting cloud computing applications consume huge amounts of energy, contributing to high operational costs and carbon footprints to the environment. With energy shortages and global climate change leading our concerns these days, the power consumption of data centres has become a key issue. The area of Green computing is also becoming increasingly important in a world with limited energy resources and an ever-rising demand for more computational power. Therefore, we need green cloud computing solutions that can not only save energy, but also reduce operational costs. In this paper, an architectural framework and principles that provides efficient green enhancements within a scalable Cloud computing architecture with resource provisioning and allocation algorithm for energy efficient management of cloud computing environments to improve energy efficiency of the data centre. Using power-aware scheduling techniques, variable resource management, live migration, and a minimal virtual machine design, overall system efficiency will be vastly improved in a data centre based Cloud with minimal performance overhead.

Keywords: Cloud Computing, Green Computing, Virtualization, Energy Efficiency, Resource Management, virtualization, Scheduling.

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INTRODUCTION

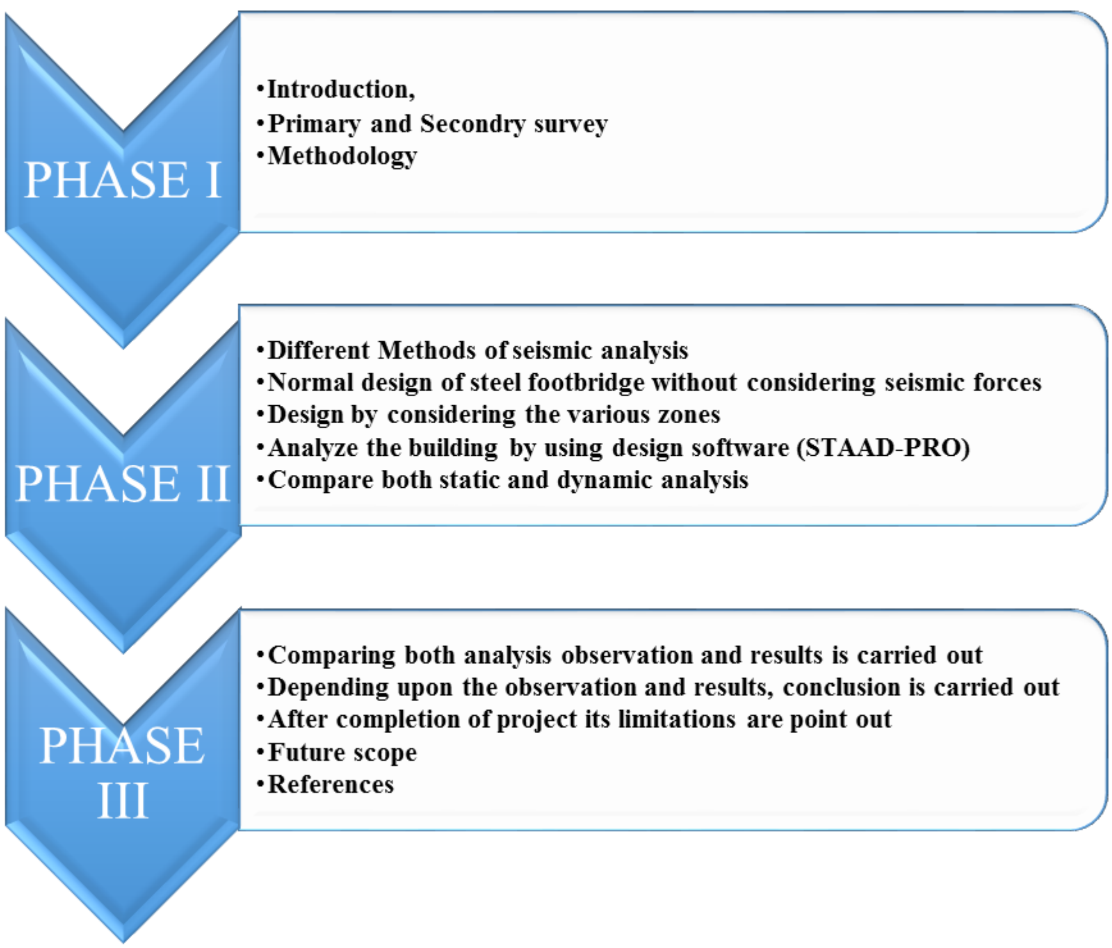
In recent years, there has been a growing trend towards the construction of lightweight footbridges. Due to its reduced mass of such structures, the dynamic forces can cause larger amplitudes of the vibration. The more slender structures become, the more attention must be paid to vibration phenomena. The increase of vibration problems in modern footbridges shows that footbridges should no longer be designed for static loads only. But fulfilling the natural frequency requirements that are given in many codes restricts footbridge design: very slender, lightweight structures, such as stress ribbon bridges and suspension bridges may not satisfy these requirements. Moreover not only natural frequencies but also damping properties, bridge mass and pedestrian loading altogether determine the dynamic response. Design tools should consider all of these factors. Provided that the vibration behavior due to expected pedestrian traffic is checked with dynamic calculations and satisfies the required comfort, any type of footbridge can be designed and constructed. If the vibration behavior does not satisfy some comfort criteria, changes in the design or damping devices could be considered. Thus , the aim of paper is to carry out stability analysis of Steel Foot Bridge for safety and security of human resources.

LITERATURE REVIEW

A brief review of previous studies on the behavior of various structures against seismic forces. This literature review focuses on recent contribution related to seismic analysis of steel bridges, buildings and past efforts most closely related to the need of the present work. Here, some literature reviews to study seismic analysis on various structures are studied from various journals like, IOSR Journal of civil engineering, IJPRET journal engineering and technology.

Mr.Dushyant A. Zamre, Miss. Aditi H. Deshmukh (1)2015,In this the authors states total foot bridge, Footbridges are small, but important, because they are usually presented in townscape. The appearance of footbridges, and indeed of any other bridges, in a town, is a major concern for designers. Increasing strength of new structural materials and longer spans of new footbridges, accompanied with aesthetic requirements for greater slenderness, are resulting in livelier footbridge structures... During footbridge vibration, especially under crowd load, it seems that some form of human–structure interaction occurs. The problem of influence of walking people on footbridge vibration properties, such as the natural frequency and damping is not well understood, let alone quantified. In the study done by E.T.Ingolfsson , C.T..Georgakis & J.Jonsson (2), a comprehensive review of studies related to pedestrian-induced lateral vibrations of footbridges is provided, primarily focusing on studies published within the last decade. It is shown in the study that a significant amount of research has been carried out within each of the three categories, but there is only limited interconnection, particularly between the mathematical models on one side and the empirical observations on the other. P.Kumar and A.Kumar (3) studied the effect of human vibaration induced in the foot bridge. They studied and mentioned that Several structures are subjected to human loading, for example, floors, footbridges, stadium, etc.. Consequently the modern structures have become flexible and prone to human induced vibrations..Mr. Dushyant A. Zamre, Miss. Aditi H. Deshmukh(4)2015,authors describes The appearance of footbridge, and indeed of any other bridges, in a town, is a major concern for designers. Increasing strength of new structural materials and longer spans of new footbridges, accompanied with aesthetic requirements for greater slenderness, are resulting more lively footbridge structures. In the past few years this issue has attracted great public attention. Živanović, S., Pavić, A. and Reynolds, P. (5),2005,In this the author studied ,The literature survey identified humans as the most important source of vibration for footbridges. However, modeling of the crowd-induced dynamic force is not clearly defined yet, despite some serious attempts to tackle this issue in the last few years. The vibration path is the mass, damping and stiffness of the footbridge.. The problem of influence of walking people on footbridge vibration properties, such as the natural frequency and damping is not well understood, let alone quantified. Faraz Sadeghi, Ahmad Kueh, Ali Bagheri Fard, and Nasim Aghili(6)In this paper the authors studied numerically the various types of human running dynamic loads and compared to assess vibration characteristics of the light and slender composite footbridges.. Furthermore, it is shown that the investigated structure provides sufficient human comfort against vibrations for all the examined three types of running loads. J.Bien,P.Rawa,J.Zwolski(7)In this research the author predict, Forced vibration test is a method enabling us to analyse the changes of dynamic characteristics of steel bridge structures. In some cases it helps monitor their technical condition. In this paper a procedure of a monitoring system applied by team from the Wroclaw University of Technology is described. A comprehensive computer-based system for programming and control of vibration tests as well as for data acquisition and processing is presented. As an example of practical use of the monitoring system, results of steel footbridge tests are shown. The tested suspended structure after renovation was equipped with mass dampers thus special attention was paid to the identification of dynamic characteristics changes caused by the dampers. Philip ICKE(8)2011, This paper aims to highlight the benefits of using finite element (FE) analysis for different types of footbridge design and illustrate those benefits with reference to a diverse range of urban regeneration footbridges of various construction materials that are either under construction or have been completed in recent years.. The paper concludes that the use of finite element analysis can lead to more efficient, cost-effective footbridge designs and that its use is just as valid for low-cost „practical‟ footbridges as it is for the design of more technically advanced and expensive „iconic‟ structures. M.Constantinou [9] .this paper by Dr. Michael Constantine describes the seismic protection of a steel multi girder highway bridge. The effect of added viscous damping is also investigated, and is found to greatly enhance the performance of the isolators, even though the dampers required are rather small. M. Constantinou, M.Symans, P.Tsopelas, D. Taylor (10), Experimental study of both a moment frame building and a single span bridge, both with and without viscous dampers, are described here. Addition of viscous dampers significantly reduced both drifts and shear forces.

RESEARCH METHODOLOGY



DETAIL STUDY & DESIGN

Design a Foot bridge with the following given data:

Span = 24m

Width of walkway = 4m

N-type lattice Girder with 8 panels laterally supported by rackers.

110m thick R.C.C slab & Floor finish = 0.75kN/m²

Live Load = 5 kN/m²

The Following are the Design Steps:

1. Given Data:

Span of Bridge = 24m

Width of walkway = 4m

N-type Lattice Girder = 8 panels

Thickness of RCC Slab = 110mm

Loadings:-

2. Geometry of Lattice Girder:

a) Assuming depth of girder = Span/No of panels =24/8=3m

{Span/5 ≤ Span/8}

b) Length of panel = Span/no of panels =24/8=3m

c) Length of Vertical member=3m

d) Length of Diagonal member = √(Length of Vertical member)² +(Length of panel)² =3√2

3.Design of Cross Beam:

a) Dead load = 0.110 ×25 =2.75kN/m²

b) Floor finish = 0.75 kN/m²

c) Live load = 5.0kN/m^2

d) Total load = 8.5 kN/m^2

e) Load per unit Length = 8.5 × 3=25.5 kN/m

Assume self weight of cross beam 0.5 kN/m

Total load = Load per unit Length + 0.5=26 kN/m

Factored load = 1.5 ×26=39

f) Maximum Bending moment = $Wl^2/8$

g) Factored Bending Moment = 1.5 × 26×4^2/8=78kN.m

h) Max Shear force = Wl/2 =1.5 × 26×4/2=78kN

i) Factored Shear force = 78kN

Considering compression flange of beam fully laterally restrained

Plastic section modulus required:-

Zp(req) = M × ϒmo/fy=78×10^6×1.1/250=0.34×$10^6$$mm^3$

Shape factor = Zp (req)/ Ze =0.3×$10^6$$mm^3$

Now by using Steel Table:

Select the **ISLB275**

Section properties are D=275mm,b_f=140mm,t_f=8.8mm,t_w=6.4mm,I_{xx}=5375×$10^4$$mm^4$,$Z_{xx}$=392.4×$10^3$$mm^3$

Z_p provided=(392.4×10^3) ×1.14=447.3×$10^3$$mm^3$>340×$10^3$$mm^3$ hence O.K

3. Section Classification according to IS 800-2007

ϵ = (250/fy)= 1

a) Flange Criteria = b_h /t_f=(140/2)/8.8=7.95<9.4

b) Web criteria = d/t_w=(275-2×8.8)/6.4=40.2<84

Hence section is plastic.

4. Plastic section:-B_b = 1

Check for moment Resistant Capacity

Md = $B_b \times Z_p$(provided) $\times f_y / \Upsilon_{mo}$ =1×(447.3×10^3)×250/(1.1×1000)=101.7kN/m>78kN/M

Safe.

5. Check for shear resisting capacity.

Design shear V_d =0.525×$A_v f_v$= 0.525×(275×6.4)×250/1000= 231KN

0.6V_d=0.6×231=138.6kN>78kN hence safe

6. Check for deflection

δ= 5×WL^3/384×E×I_{xx} = 8mm<span/250(=16.6mm) hence safe

7. Design of N-Type Lattice girder:-

a) Dead load intensity = 3.5 × 4/2=7.0kN/m

b) Self weight of truss in meters = 0.7kN/m

c) Total D.L = 7.7kN/m

d) Factored D.L= 7.7 × 1.5=11.6kN/m

e) Live load =5 × 4/2=10kN/m

f) Factored L.L = 1.5 × 10=15kN/m

g) Total factored load = 11.6+15=26.6kN/m

Forces In Chord Members

Members		Area of factored bending force			
Top Chord	Bottom chord	I.L Diagram	Load kN	Moment kNm	F=BM/d Kn
U_1U_2	L_2L_3	31.5	26.6	838	293
U_2U_3	L_3L_4	54	26.6	1436.4	479
U_3U_4	L_4L_5	67.5	26.6	1795.5	598.5
U_5U_6	-	72	26.6	1915.2	638.4

The force in member=bending moment at opposite node/depth of truss

Web Members

Forces in vertical members

Vertical member	Area of I.L Diagram		Net area	Dead load net area×11.6	Live load Force		Total force	
					+ve area×15	-ve area×15	Max.	Mini.
	+ve	-ve	(2+3)	(4×11.6)	(2×15)	(3×15)	(5+6)	(5-7)
1	2	3	4	5	6	7	8	9
U_1L_1	10.5	-	10.5	121.8	157.5	0	279.3	121.8
U_2L_2	7.71	-0.21	7.49	86.9	115.5	-3.15	202.4	83.75
U_3L_3	5.36	-0.86	4.5	52.2	80.4	-12.9	132.5	39.3
U_4L_4	3.40	-1.93	1.47	17.05	51.0	-28.95	68.05	-11.9

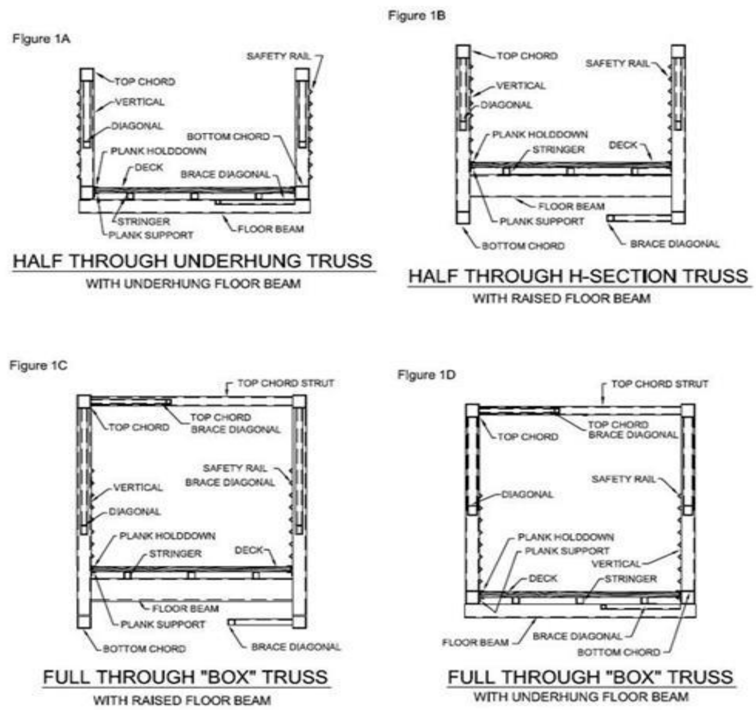
Forces In Diagonal Members

Member	Total Force	
	Maximum	Minimum
U_1L_2	395.00	86.12
U_2L_3	286.20	118.6
U_3L_4	187.50	55.6
U_4L_5	96.2	-16.8

A force in diagonal members' are√2 times the forces in vertical members.

Design Forces

Design force for top chord member=638.4kN
Design force for bottom chord member=598.5kN
Design force in vertical web member=279.3Kn Compression and 11.09 Tension Design force in Diagonal web member=395Kn Tension and 16.8 Compression



CONCLUSION:

By carrying out the analysis and design of considered foot bridge it is very clear that the safety and stability of structures depends upon the combination of load, location of it and the type of material used. It is also clear that when foot bridge is subjected to normal forces tension is developed in inclined member , similarly compression is developed in vertical member and at junctions it becomes must to make is stable enough so as to resist joint forces as failure at such member joints lead to failure of structure. With careful designing and analysis the decision making for use of materials helps to reduce amount of material , money as well as makes life if users safe.

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