Analysis and design of skywalk structure of high rise twin building

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Abstract-It is well known that high-rise buildings act as very important roles in modern cities. First of all, tall buildings can be effectively used to meet the requirements of modern society and solve the problem of limitation of construction site resources. On the other hand, they are the signals of economic properties and civilization. Nowadays high-rise buildings rise higher and higher, with more and more complex and individual plan and elevation, such as multi-tower buildings. "Sky Bridge", "skywalks" or "elevated walkway" bring up images of a narrow, glass walkway connecting two towers usually commercial the only purpose of which, is to let people go from one meeting to the next without having to travel up and down or through fresh air. Dynamic actions are caused on buildings by both wind and earthquakes. But, design for wind forces and for earthquake effects are distinctly different. In this research analyze twin tower structure of G+ 25 with having steel sky walker bridge at 20th floor, the structure analyze for seismic forces, and design steel sky walk bridge for the same by using Staad-Pro

1. INTRODUCTION

In recent years, the architectural design of tall buildings has become new and flashy, leading to a diversity of appearance and dynamic behavior. In addition, due to lack of land in densely populated areas, especially in big cities, more and more high-rise buildings began to be built in the immediate vicinity. There is therefore an increasing trend towards the construction of high-rise buildings in adjacent areas as a form of connected housing. [6] It is a structure consisting of many structures connected by connecting structures such as sky gardens and sky bridges. Therefore, there are many types of connections: fixed, semi-fixed, articulated, etc. There are two big symbols that show this trend; Petronas Towers in Malaysia and Marina Bay Sands in Singapore. These home connections are often too developed to be effective. More importantly, seismic response is an important consideration in structural design, as the response of the main structure depends on many parameters such as seismic properties, soil type and materials. FEM is a mathematical technique that can be used to analyze many engineering problems under static, dynamic, linear or nonlinear conditions. [6]

The best and most practical finite element method tools for commercial and academic research. It provides a good analysis of dynamics such as wave and seismic loads in the structure. Research studies on the seismic response of individual high-rise buildings have been reported by different researchers. Additionally, many studies have been published focusing on the response from the wind in the connection of the building connected by the connection structure. [9] These tests provide a better understanding of the dynamic response of buildings. A few important aspects of creating this wind-resistant structure are listed. For example, problems with vibration modes and natural frequencies of universally coupled structures, the effect of inter-building composite structure of objects, and field structure caused by wind. However, due to the complexity of this problem, only a few studies on the seismic response of building systems can be found in the open literature. [9]

A. Skywalk

One way to improve the safety of tall buildings is to provide horizontal escapes from height using sky bridges connected to the towers. If the building is in danger, especially in an emergency situation in a high-rise building, the idea that those living higher above the ground can be evacuated seems reasonable. The inclusion of flights in high-rise buildings in Hong Kong has recently been proposed as a strategy to improve fire safety in the city with high-rise buildings. In Hong Kong,

regulations for new high-rise buildings above 25 floors require shelter. The additional use of these shelters for escape and business purposes via high-connection "sky bridges" will both increase the life safety of the people living in the building and increase the economic importance of many of them. “dead” spaces. [6]
Tall buildings in some cities, such as Hong Kong, need shelters. All new buildings above 25 floors must have an escape at every 25th floor throughout the building. The integration of the shelter floor into a building is important not only in terms of the additional requirements required by other fire protection measures (such as ventilation, water absorption and fire protection floors), but also in its impact on them. rentable area of the house. From a developer's perspective, a complete dead end of two floors of a 75-storey building could result in a significant loss of rental income. It depends on whether the "front rate" is broken or not. [9]

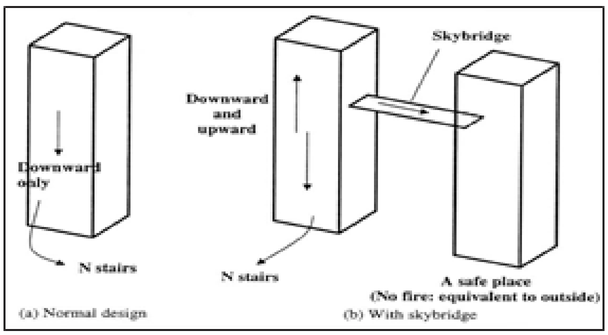


Fig 1 Evacuation in high-rise building.

B. Howe Truss
Flanges, purlins, and diagonals make up a Howe truss bridge; the diagonal parts are in compression and the vertical elements are in tension.

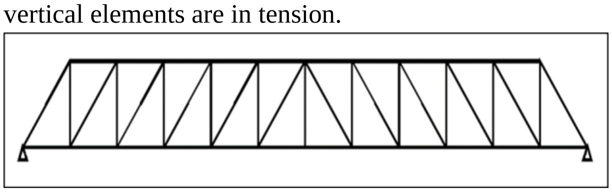


Fig 2 Howe Truss

C. Pratt Truss
This truss differs from the Howe truss in that its diagonal members slope downward towards the centre.

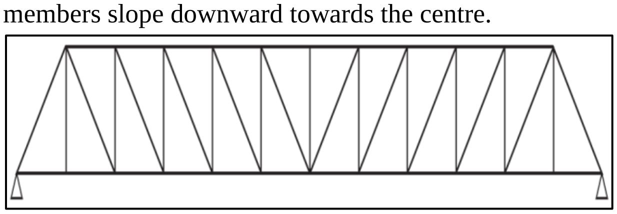


Fig 3 Pratt truss

2. STATE OF DEVELOPMENT

V. R. Shinde et. al. (2021) A bridge must be built to be safe against all loads and forces that may occur throughout its life. These loads include not only the weight of structures and vehicles but also natural loads such as wind and snow. These loads can be independent but often occur as a simultaneous combination of two or more loads. In our project, the analysis and design of a 70 m long, 7.5 m wide and 6 m high steel truss bridge was discussed. The analysis was performed using the staad pro program. Maximum axial force, shear force, torsion values and moments were examined in the project. [23]
Nandar Lwin et. al. (2014) This study will highlight the important role of historical period in examining the performance of truss bridges. Truss bridges have long been a popular type of bridge in our country and are available in many sizes, shapes and forms. However, many bridges are not currently designed for seismic loads as specified by the American Association of State Highway and Transportation Officials (AASHTO). Today, our government focuses on construction and sees making existing buildings earthquake resistant as a major project. The aim of this study is to analyze and design a truss bridge in a high earthquake zone. In case studies, seismic retrofit behavior is determined by performance level. However, modeling the seismic analysis and evaluation process is difficult due to the complexity of the size, shape and form of truss bridges. Therefore, the aim of this article is to conduct a study on the seismic evaluation of an existing steel truss bridge using time history analysis (THA) to determine part of its seismic performance category. This analysis uses AASHTO-LRFD 2007 guidelines. Types of plastic hinges used in earthquake-resistant construction are reviewed by a committee approved by the California Department of Transportation (CALTRANS). Seismic loads are based on the International Building Code (IBC 2006). SAP 2000 software as analysis tool. The hypothetical bridge model is 1050 feet long, 48 feet wide and 58 feet high. This includes three lanes, two for cars and one for trains, and each line has footpaths. HS 20-44 is considered a freight car and the 1929 Meter Track Standard Heavy Minerals is considered a freight train. According to AASHTO specifications, the total load of the bridge is calculated based on strength limit state-III, cloud state limit state-I and serviceability limit state-I. This study discusses the maximum displacement, rotation and

acceleration occurring at different points, at different times and at different distances. The weight of the bridge structure is 667 kip-sec2/ft and its self-weight is 21451 kip. Basic mode occurs in 0.576705 seconds. The mode used is based on the Ritz vector acceleration mode. [24]

Surendra Chaurasiya et. al. (2019) Symbolic towers suitable for all processes are in fashion. These buildings are not only designed to meet current needs, but are also seen as having international control and are used as a reference for the world. Many buildings have been built so far, all iconic like the Petronas Towers in Kuala Lumpur, the Orchard Towers in China, the Empire State Building in India, the Palm Tower in Doha and the list goes on... Not all over the world, but in India. There are many twin buildings under construction. This structure is where the difference between two towers is due to bridge or RCC frames, steel connections etc. It is obtained by connecting it in various ways such as. This article examines various documents to understand the content and adjust the needs. Review of many research papers, including existing rigs, helped identify research objectives and optimization. [1]

Nisarg Patoliya et. al. (2023) In recent years, flyovers have become popular due to their beauty and recreational facilities. They also serve many structural purposes, such as controlling movement and drift. Steel cages or composite materials are generally used in the construction of overpasses. However, this article proposed a new method to build overpasses using reinforced concrete (RCC). Using RCC to build overpasses has many advantages, including increased strength and reduced maintenance. Although the sky bridge is tightly connected to the last release part on both sides, thus the damping of the building is improved. In this study, ETABS19 software was used for modeling and analysis. This article focuses on seismic forces in buildings. In this study, two buildings of similar height, 20, 24 and 28 floors, are connected to each other by one, two or three sky bridges on different floors. The aim is to determine the most efficient location and number of overpasses to reach the best solution. This study aims to compare the structural parameters of RCC overpasses such as storey displacement, storey displacement and foundation shear. This study provides insights into the design of overpasses using RCC materials and may form the basis for future research on this topic. [25]

Vanni Nicoletti et. al. (2023) Vibration is an important issue in the design of pedestrian bridges today. Many competing pedestrian bridges have longer spans and more efficient materials; This allows for deeper structures and higher live-to-dead load ratios. As a result of this difference, many pedestrian bridges are more susceptible to vibration when subjected to dynamic loads. Besides wind loads, the most dynamic load on pedestrian bridges is foot traffic resulting from human movement. This paper deals with the experimental and numerical dynamic characterization of a new steel-timber cable-stayed pedestrian bridge. The pedestrian bridge was dynamically tested under ambient vibrations in the field, and the results captured the actual dynamic behavior of the pedestrian bridge. The dynamic response on pedestrian dynamic loading was also studied and compared with the limits provided by the large international pedestrian bridge conforming to numerical analysis and guidelines. A numerical model of the pedestrian bridge was also created and updated as the experiment took place. The test model was used to numerically evaluate the validity of the pedestrian bridge and verify the accuracy of the design by following pedestrian simulation instructions. The purpose of this article is to add to existing knowledge on the measurement of foot competition to support the development of new and future models and to demonstrate its results by accepting the requirements of pedestrian bridge usability evaluation rules and guidelines. Calibrate the numerical model. [26]

Wensheng LU et. al. (2018) This paper reports testing of various scale multi-tower high-rise building models on the shake table. The assumption of floor slabs is clearly unsuitable for the analysis of many buildings. A new analytical model is proposed that takes into account the effect of changing the soil. Compare theoretical dynamic behavior with test results. This article also discusses the impact of combining layers of high towers and rigid foundations on the dynamic behavior of the structure. Some recommendations and suggestions have been made. As we all know, tall buildings play an important role in today's cities. First of all, high-rise buildings can be used effectively to meet the needs of today's people and to solve the problems arising from the limited resources of construction sites. On the other hand, they are symbols of business and prosperity. Today, tall buildings are becoming increasingly taller, and like many buildings, their plans and appearance are becoming more complex and individual. [2]

A. Wood et. al. (2005) As a result of the World Trade Center (WTC) incident, high-rise building safety research focused almost exclusively on vertical structural, fire protection, and evacuation improvements. Although this study is important in terms of increasing the security of high-rise buildings, it is not sufficient on its own. This issue should be addressed at a more fundamental design level, not as an alternative but in addition to the previously reported security improvements. It is recommended that horizontal evacuation of high altitudes be done by connecting a sky bridge between the towers. This is a good option if a fire cuts off the vertical (usually downward) escape route of a tall building. Overpasses can improve escape routes without climbing fire escapes. The Petronas Towers in Kuala Lumpur, Malaysia prove all these points. There are many large cities in the east that have many connections with tall buildings (high-rise cities). The possibility of connecting the existing shelter to the sky bridge is worth considering, especially for buildings owned by the same developer. Take the existing sky bridges of high-rise buildings in Hong Kong's central business district as an example. Guidelines will be developed to improve evacuation. This can be expanded into a strategy for the integration of sky bridges into high-rise buildings designed to improve fire safety in high-rise buildings worldwide [3]

Hitesh A. Patel et. al. (2015) Pedestrians are one of the largest groups of road users and also the most vulnerable. Ahmedabad has played an exemplary role in providing infrastructure to all sections of society. The revenue intersection I chose is an intersection and it faces problems such as high number of pedestrians, conflict between people and vehicles, wide travel area and popular area, regular traffic, and mixed pedestrians. mode. Pedestrian planning efforts to improve pedestrian amenities at these intersections are ongoing. Examining the adequacy of pedestrian facilities, pedestrian surveys (e.g. pedestrian numbers) and pedestrian interviews, as well as traffic surveys and reviews of the provision of existing pedestrian facilities, complies with HCM (2000) and the Pedestrian Facilities Guidelines IRC 103:2012.. [4]

Amitabh Kumar et. al. (2011) Sky Towers has four tall buildings: Sky, Sky Forest (twin towers) and SKY Suites, with heights ranging from 257 to more than 300 meters. It is located in Mumbai, India, and construction continues on an area of approximately 8 million square meters. People living in the heart of Mumbai are creating changes during construction, office work getting mixed up and recently the introduction of automatic machines and other products used in the Mumbai market. Choose plain PT sheet considering the speed and economy of construction. To shorten the construction period, the ACS (automatic climbing system) core construction method is used. Climbing platform SCP and automatic climbing formwork are used according to the core geometry and predetermined construction sequence. Using the drop head universal slab formwork provides flexibility in different geometries, early dismantling and rapid crane-friendly construction. A small section of perimeter wall used to guide climbing patterns. MEVA-ALUFIX panels are used on columns and other walls. After examining the tower geometry and logistics, we prepared the equipment. Eight cranes were placed on stage. 4 efficient pumps are used at a maximum height of 150 m, and 4 high pressure pumps have been prepared and reserved for a height of 150 m. Seven self-climbing rock pouring arms were placed on the stage. Design changes affect the selection and placement of equipment. The height difference poses a challenge in optimizing and optimizing the advancement of the ACS, tower crane and boom extension. Equipment development is difficult due to limited space, rapid construction, and crowded areas. High performance concrete and temperature control are provided within the factory, while other quality (M40, Lean Concrete) is provided externally. Designs are constantly changing during construction due to changes in raw materials.[5]

3. SUMMARY OF LITERATURE AND GAP

By analyzing the data, we can see which works have been completed on the twin bridge and which works remain limited or have not been completed. Previous studies have only examined overpass structures with certain lattice structures through vibration and wind analysis. The need to understand the context of previous research and correct patterns. There are many advantages to using steel in suspension walkways, including durability and less maintenance. In further research, it is necessary to use Staad Pro to analyze the vibrations of various truss types of the Sky Walk bridge with seismic loads from the finite element method, and to use Staad Pro software to analyze and design the business model of the products. twin tower Skywalk and IS800 Perform tests based on wind and vibration loads.

4. PROBLEM STATEMENT AND ANALYSIS

The Sky walk bridge analyses with effective span 25m with different type truss patterns. Design economic structure of Skywalk for the Twin Tower Building with using Stadd Pro Software analysis As per IS800 for wind and vibration loads

Truss Types Used
1) Pratt Truss
2) Howe Truss

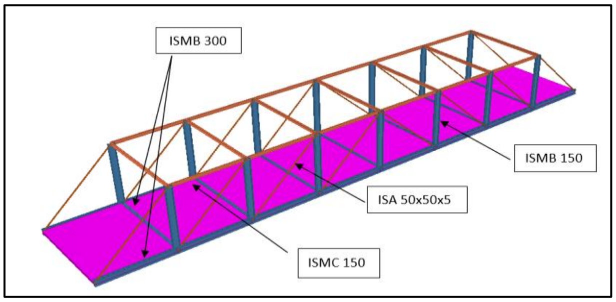


Fig 4 Truss Model

A. Truss Modelling And Analysis

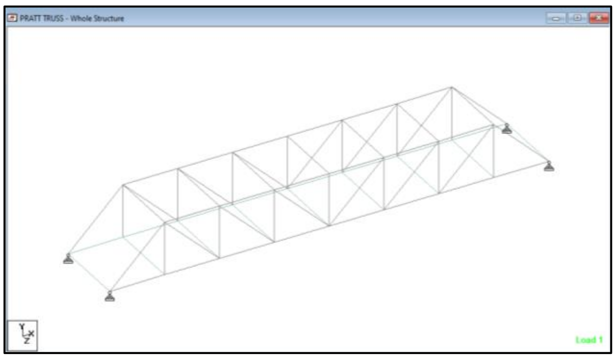


Fig 4 Pratt Truss

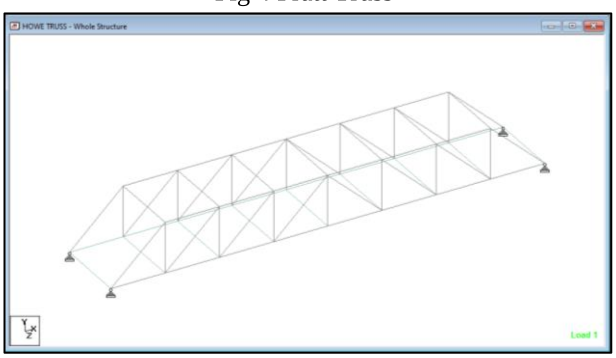
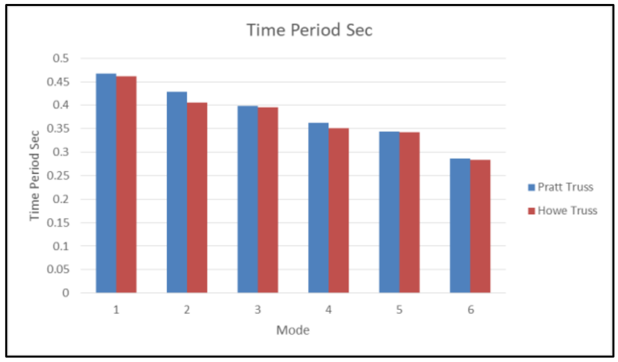


Fig 5 Howe Truss

Table 1 Time Period Sec

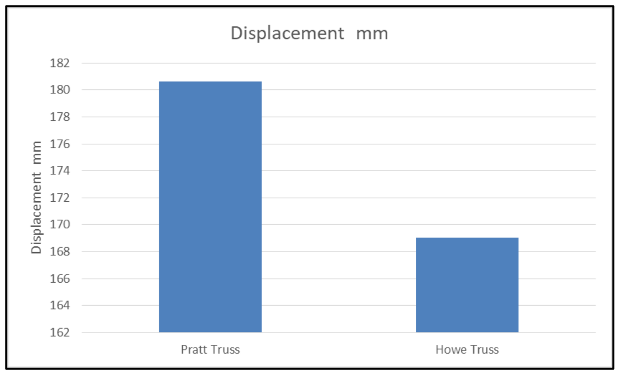
Time Period Sec		
Mode	Pratt Truss	Howe Truss
1	0.467	0.461
2	0.428	0.405
3	0.399	0.395
4	0.362	0.351
5	0.344	0.342
6	0.287	0.283



Graph 1 Time Period Sec

Table 4.3 Displacement mm

Displacement mm	
Pratt Truss	Howe Truss
180.64	169.02



Graph 2 Displacement mm

B. Results Of Howe Truss 2.5 X 2.5 m Span

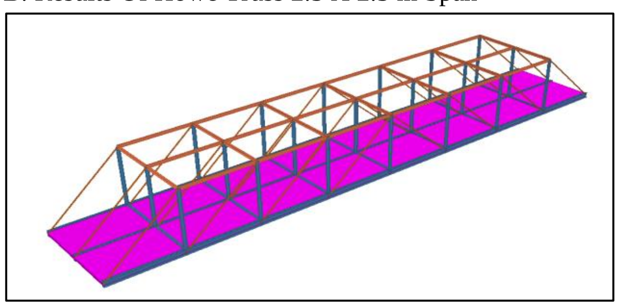
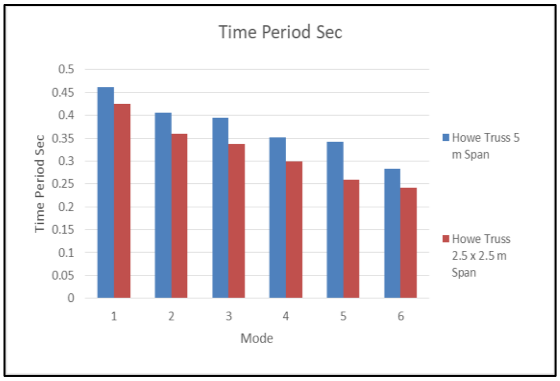


Fig 6 Howe Truss 2.5 x 2.5 m (Render View)

Table 4.4 Time Period Sec

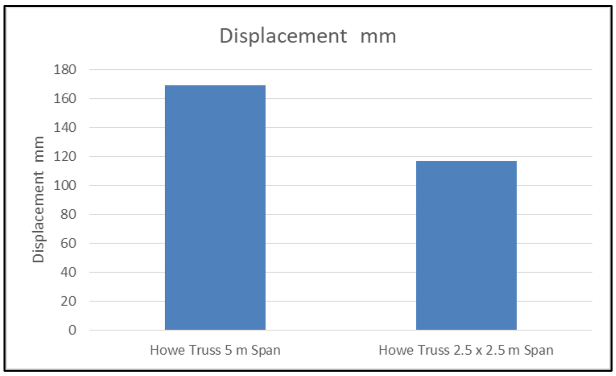
Time Period Sec		
Mode	Howe Truss 5 m Span	Howe Truss 2.5 x 2.5 m Span
1	0.461	0.425
2	0.405	0.359
3	0.395	0.338
4	0.351	0.299
5	0.342	0.259
6	0.283	0.242



Graph 3 Time Period Sec

Table 4.6 Displacement Howe Truss 2.5 x 2.5 m

Displacement mm	
Howe Truss 5 m Span	Howe Truss 2.5 x 2.5 m Span
169.02	117.03



Graph 4 Displacement Howe Truss 2.5 x 2.5 m

5. CONCLUSION

The idea of using sky bridges to connect two or more buildings has been around for a while. Sky bridge high-rise buildings are a unique architectural style that has become popular in recent years. Constructing a tall building with sky bridges has its own challenges. The design and construction of these structures requires consideration of many factors such as wind loads, seismic loads and safety regulations. Two types of bridges were used in the analysis of the suspension bridge: Howey truss and Pratt truss. The finite element method has become a powerful tool for the numerical solution of many engineering problems. This is how partial equations are created and solved. The response of the Sky Walk bridge under forced vibration will be determined. Results from the Sky Walk Bridge were analyzed to understand the Pratt response spectrum analysis method and how each type of truss provides better performance than Pratt trusses. Two different types of Howe trusses (one 5 m long and the other 2.5 x 2.5 m long) were analyzed and according to the results, no significant difference was found after the delay change.

6. FUTURE SCOPE

Buildings connected by sky bridges have different behaviors depending on their location, stability, and how they are connected to other buildings. Sky bridges can be connected to buildings in many ways, including children, hinges, and negative connections. In this study, we considered the rigid connection to the overpass structure and will use 5 m long Howe type trusses to build and develop the twin tower structure.

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