

ANALYSIS OF AERODYNAMIC MODIFICATION OF THE SHAPE OF THE TALL STRUCTURE - A REVIEW

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Abstract

The structures that are man-made are bluff- bodies. During the structural analysis of a tall building, its stability under wind forces is of a major concern. Being a bluff body, the aerodynamic study plays a critical role in the determination of the principal response of a high- rise building to wind forces. Wind action can reduce the proceeding of the whole structure

.because tall structures are in a continuous motion during wind circumstance hence ,it is essential for structural engineers to develop a system ,which can increase modal mass to reduced wind induced motion.

Now a days it is observed that urbanization area is abruptly increases, with increment in population. Hence, the land requirements are increases day by day to fulfillment the needs of residents. To fulfill the need, now a days in metro city multistory buildings are constructed. And it was observed that during structural analysis that wind action is play a very important role in the stability of tall buildings.

In present study an attempt has been made to minimize the impact of wind on tall buildings. The aerodynamics action will highly influences the high rise buildings. Because high rise buildings is continuous in motion during wind action and causes instability to building structures, which can causes hazardous impact to health as well as wealth.

In present study to minimize this impact, modification of aerodynamics action has been taken to reduced the impact of wind action on tall buildings. For this purpose fours cases has been studied, in which four different type of structural design which include cross sectional shape, corner geometry, sculptured buildings tops and vertical opening of buildings has been taken and studied against the wind action.

Keywords— Aerodynamic shape , wind load , Drag coefficient ,Model analysis, Drag Force, Tall str.

I. INTRODUCTION

The lateral loads on the buildings is plays an important role in the design of high structures. The structures response to wind depends on the wind's characteristics. Tall buildings, usually designed for office or commercial use, are among the most distinguished definitions of space in American urbanism's twentieth-century architectural history. According to National Building Code 2005 building having height more than 15m of India is called a high rise building. Vertical growth of buildings has become an ultimate option available due to the rapid growth of population, the high cost and, for improvement in aesthetic view of city and restriction in horizontal growth due to less space. The Wind can be defined as the large-scale horizontal movement of free air

In metropolitan cities the creative reinterpretations of the building type by architects, the inadequacy and high cost of land in urban areas, the desire to prevent disorganized urban expansion, the need to maintain significant agricultural production, the idea of skyline, the impact of cultural significance and prestige have all contributed to the fact that buildings may produce excessive construction movement, the dynamics nature of wind is a critical issue, negatively affecting occupancy comfort and serviceability.

Moreover, the human response to building motion is a very complicated phenomenon concerning both physiological and psychological features. In addition, excessive building movement can cause noise and crack doors, damage non-structural elements such as curtain walls, break glasses, reduce fatigue life, elevator and equipment malfunction, and cause structural damage or even collapse.

Various design approaches and modifications are possible, ranging from alternative structural systems to the introduction of damping systems to ensure the functional efficiency of flexible structures and control the movement of tall buildings caused by wind. Among these approaches, an extremely important and effective design approach is aerodynamic structural modifications, including modifications of the cross-sectional form of the building and its corner designs, sculpted building tops, and horizontal and vertical openings by construction.

Now a days, it is assume that tall buildings are symbol of power, technology, landmark of metro cities but bedside of this if care was not taken before construction of these buildings it can cause undeniable negative effects on the quality of urban life.

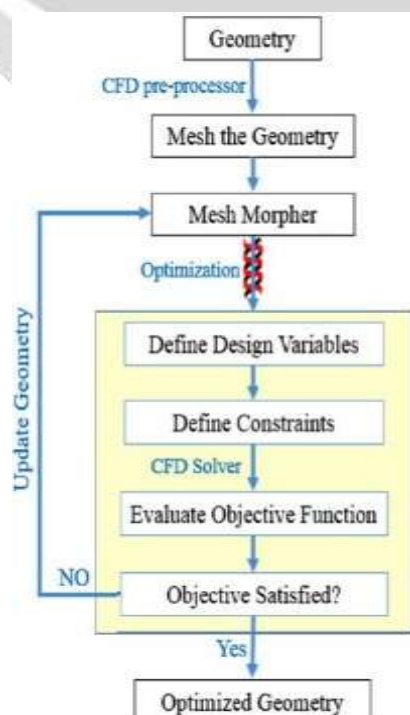
To overcome this method several design and modification are possible. Ranging from alternative structural systems to the addition of damping systems in order to ensure the functional performance of flexible structures and control the wind induced motion of tall buildings. And one of the most important method is the aerodynamic modifications in architecture, including, modifications of building’s cross-sectional shape and its corner geometry, sculptured building tops, and horizontal and vertical openings through building. By doing this the wind flow pattern around the tall structures can minimize the response of wind action around the buildings. An extremely important and effective design approach among these methods is aerodynamic modifications in architecture, including, modifications of building’s cross-sectional shape and its corner geometry, sculptured building tops, and horizontal and vertical openings through building. By changing the flow pattern around the building, aerodynamic modifications in building shape, i.e. an appropriate choice of building form, could moderate wind responses when compared to original building shape

Tall buildings, which are usually designed for office or commercial use, are among the most distinguished space definitions in the architectural history of American urbanism in the twentieth century. They are primarily a reaction to the rapid growth of the urban population and the demand by business activities to be as close to each other as possible. Architects’ imaginative reinterpretations of the building type, the inadequacy and high cost of land in urban areas, the desire to prevent the disorganized urban expansion, the need to preserve significant agricultural production, the concept of skyline, influence of cultural significance and prestige, have all contributed to force buildings upward.

Today, it is virtually impossible to imagine a major city without tall buildings. Tall buildings are the most famous landmarks of cities, symbols of power, dominance of human ingenuity over natural world, confidence in technology and a mark of national pride; and besides these, the importance of tall buildings in the contemporary urban development is without doubt ever increasing despite their several undeniable negative effects on the quality of urban life.

II. OVERVIEW OF WORK

Tall buildings have more problems than low rise buildings. Although the tall buildings produce powerful iconic images and visibility, the construction cost is considerably larger and the design of them is much more difficult. Moreover, recent skyscrapers pursuit free-style forms distinct from traditional rectangular prisms as well as the



height unimaginable in the past. This is due to the desire for revolutionary and innovative
 Fig.2.1 Aerodynamic shape optimization utilizing CFD

shapes of tall buildings from humans. This insatiable human desire, however, causes many severe problems in habitability, pedestrian comfort, wind induced noise and interference effect of neighboring buildings

III. LITERATURE REVIEW

Literature based on the modelling of multi-storey building using floating column and transfer beam under seismic behaviour. From the detailed literature review, inference is studied.

Paniagua and García (2015)

The adjoint method is used in this paper for the aerodynamic optimization of the nose shape of a train. This method has been extensively applied in aircraft or ground vehicle aerodynamic optimization, but is still in progress in train aerodynamics.

Here we consider this innovative optimization method and present its application to reduce the aerodynamic drag when the train is subjected to front wind.

Elshaer , Bitsuamlak ,(2016)

In this paper Huge amount of resources is drawn to control loads and vibrations caused by wind.

Large portion of those expenses and materials can be saved by improving the aerodynamic performance of tall buildings. This improvement can be reached by modifying the outer shape of tall buildings locally at the corners or globally over the height and the width of the building.

In the current study, improving the aerodynamic performance of tall buildings is conducted by adopting a recently developed aerodynamic optimization procedure (AOP).

Elshaer et.al.(2017)

Numerical methodology to assess changes in wind load on buildings as a city develops is developed Generic and realistic city topology test cases are presented

Variation of wind-induced risk with the change in urban topology is examined for both the structural and cladding system. Large eddy simulation method is used
 examines the change in wind loads on a typical tall building with generic surrounding configuration of different heights.the built environment of the Financial District, Toronto is examined for three development stages
 mean wind pressures are reduced while fluctuations are increased as the urban environment becomes denser.

Ahmed Elshaer a, Girma Bitsuamlak b,

Wind is a critical load case in many civil engineering applications including tall buildings. Huge amount of resources is drawn to control loads and vibrations caused by wind. Large portion of those expenses and materials can be saved by improving the aerodynamic performance of tall buildings.

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Neethi B.(2018)

The structures that are man-made are bluff- bodies.During the structural analysis of a tall building, its stability under wind forces is of a major concern. Being a bluff body, the aerodynamic study plays a critical role in the determination of the principal response of a high-rise building to wind forces.Tall buildings can be susceptible excessive motion during wind events that can cause occupant discomfort and reduce the overall appeal of the

structure. Further more ,these excessive motions can create high base loads, which can increase the cost of the structure

Ms. Ameena M Ansary1, at al,(2017)

The main objective of the present study is to evaluate the effect of corner modification, setback and stepping on tall buildings. Building models with a constant plan area of 1024 sq.m is considered for corner modification study and an area of 2500 sq.m for studying stepping and setback.

The models are compared in different aspects such as storey drift, storey displacement, column force, beam force, shell force, etc for different modifications

Jiming Xie(2012)

This paper summarizes the aerodynamic approaches that have been used in building design, and discusses the principles and effectiveness of these approaches. To provide a guideline for building aerodynamic optimizations,

this paper proposes an approach of assessing the effects of tapering, twisting and set-back, three common schemes in super-tall building design for wind response reductions with limited wind tunnel tests

IV. OBJECTIVE OF THE WORK

The salient objectives of the study have been identified as follows:

- 1)A comparative analysis can be done by taking the tall building models and with the different modifications with the given theories.
- 2)To evaluate the effect of corner modification on buildings to resist the wind load.
- 3)To evaluate the effect of setback on a building to resist the wind load
- 3)Also the variations of the results obtained can be analyzed through different examples.
- 4)Compression of tall structure and aerodynamically modify tall structures by software
- 5)Development of a modified formula which will incorporate all the theories their assumptions to give a unified result.

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