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REVIEW ON EFFECT OF SLANTED COLUMN IN BUILDING

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ABSTRACT

Columns are typically utilized to provide structural support for beams or arches, which are then utilized to support the uppermost portions of walls or ceilings. The term "column" is used to describe this kind of structural element that possesses particular proportional and ornamental characteristics. In today's world, there is a new trend in the fields of architecture and structural engineering in which many big structures all over the world have a complex shape such as being twisted, tapered, or tilted. This is a reflection of the modern world. These structures are revered as national landmarks and stand as a testament to the nation's progress in the field of technology. The orthogonally that normally exists between beams and columns in tall buildings is disrupted by the complicated shapes of the buildings. In particular, structures that include inclined columns are likely to have this kind of structural system present in a high frequency. The inclined column is required to display the architectural intricacy since it may simultaneously transmit gravity and lateral load. This study focuses on the seismic performance of the building with the inclined column at different angles at different heights.

Keywords: Slanted Column, Lateral stability, Structural system.

1. INTRODUCTION

According to the various ideas, the presence of eccentric loading would lead to a reduction in the column's strength. When the axial load that is being applied to the column is not concentric, also known as when the line of action of the axial load is not parallel to the central axis of the column, the column is said to be eccentrically loaded. This is the definition of the term eccentrically loaded. The eccentricity, which is primarily denoted by the letter 'e,' of the load is what causes the column to bend almost instantly. Therefore, the combined action of bending and axial loading would result in a decreased capacity for load carrying.

The typical style of high-rise buildings has been a box-shape since the 19th century, but starting in the middle of the 20th century, many different prismatic forms have been made all over the world. These changes have taken place over the course of the past 150 years. In today's world, there are many different intricate styles and iconic shapes that may be seen, such as buildings that are tilted, curved, or twisted. These novel shapes were made feasible by the development of structural systems as well as an increase in the quality of materials that could be used for structural purposes.

Column with a Slope

The inclined column is not a common type of column observed in buildings or any other structure. However, as an architectural feature or any other requirements, these types of columns are constructed. Inclined column design and construction is a challenging task as it is a bit complicated. Especially when it becomes a concrete column, this task becomes more difficult.

Let’s see what types of inclined columns are available.

- Concrete
- Steel
- Timber
- Precast

For inclined columns, it is important to determine if the element is going to be subjected on lateral forces also. So, it is necessary to determine if the column contributes to the lateral stiffness of the system or the lateral loads are taken from other structural members. The two types of columns related to lateral loading are braced and unbraced columns. Braced columns are the columns where the majority of lateral loads are taken by other structural member (core, shear walls). In braced columns the axial, shear and moment loads are caused only by the vertical loads acting eccentrically on the top of the column and by the self-weight of the inclined member. The unbraced columns are columns where the lateral loads are a major loading case except axial loading.

The shear force in columns is considered mostly in cases of big lateral loading such as earthquake and wind. When designing a column is important to determine if the column is braced or not braced. This means to determine if the column should be designed to withstand horizontal loading or not. If the main lateral loads are absorbed by laterally stiffer elements, such as cores or shear walls, then the shear reinforcement can be significantly minimized.

The mechanics of structures:

The structural system of a high-rise building is designed to cope with vertical gravity loads as well as lateral loads caused by wind or seismic activity. The structural system consists only of the members designed to carry the loads, and all other members are referred to as non-structural. The determination of the structural system for a high-rise building involves the selection and arrangement of the major structural elements to resist most efficiently the various combinations of gravity and lateral loading. A high-rise building needs to be stabilised for horizontal load and to achieve this, several different structural systems can be chosen. All of the different systems have evolved from the traditional rigidly jointed structural frame. The fundamental design for all these structural systems has been to place as much of the load-carrying material as possible around the building's external fringe to maximise its flexural rigidity.

Aim

The aim is to study the effect of using slanted column on lateral stability of high rise building.

Need Of Present Study

The Dissertation work is being carried out to achieve the following objectives:

- Comparing the lateral stability of building with conventional buildings
- Checking the ability of slanted columns to Sustain overturning moments.
- Effect of inclination of column on high rise buildings.
- This study will ignite an interest on the use of oblique column in lateral load resistant design of high rise structures.

2. LITERATURE REVIEW

Nishith B.Panchal, Dr. V.R.Patel, Dr. I.I.Pandya studied by considering the different angles of diagrid and also different storey of the building. The plan of 36m x 36m is considered with four different types of angles of diagrid that is 50.2°, 67.4°, 74.5° and 82.1° and also by considering 24-storey, 36-storey, 48-storey and 60-storey building, a comparative study is carried out and found 67.4°, 74.5° gives the better results.

Girish kumar G.M and S M Maheswarappa: Studied by considering the different angles of oblique columns and also International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV9IS080139 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by : www.ijert.org Vol. 9 Issue 08, August-2020 319 different storey of the building. The plan of 36m x 36m is considered with four different types of angles of that is 80, 84, 88, 90, 94, 100 by considering 8-storey building, comparing to multi-storeyed buildings with normal columns, the multi-storeyed buildings with oblique columns Oblique columns show 38% lesser story drift than normal columns. Oblique columns of 92, 96 and 100 degrees have 30% lesser top story displacement than conventional column. Multistoried building with oblique column of greater than 90 degree have story shear and story stiffness greater than conventional columns. Hence, the oblique columns is more seismic resistant than conventional columns.

RohitKumar Singh, Dr. Vivek Garg, Dr. Abhay Sharma presented a study on analysis of concrete diagrid structure and compared with conventional concrete building.In this study STAAD.Pro software is used for modelling and analysis and said that, Indiagrid structure, the major portion of lateral load is taken by external diagonal members who in turn release the lateral load in inner columns. This cause's economical design of diagrid structure compared to conventional structure and also Drift in diagrid building is approx. half to that obtained in conventional building.

Kona Narayana Reddy, Dr.E.Arunakanthi: presented a study on analysis of concrete diagrid structure and compared with conventional concrete building. Their study shows lateral loads are resisted by structure with Oblique columns, the top storey displacement is very much less in Oblique structure as compared to the simple RC Frame building. Structure provides more resistance in the oblique column building which makes the structural system more effective. The overall results suggested that Oblique column is excellent seismic control for high-rise symmetric Buildings.

Kai Hu, Yimeng Yang, Suifeng Mu, Ge Qu: All the results of response spectrum analysis calculated by different programs are basically similar for structures with oblique columns, while ETABS may miss the statistic of oblique columns, which need to be paid attention to in future designs. The results of time history analysis by SAP2000 and ETABS are roughly similar. However, SAP2000 does not have the concept of storey which made the post processing

much more complicated for analyzing oblique columns. Therefore, to the regular structure, ETABS is recommended and to those gymnasium or space truss structures, SAP2000 has its irreplaceable advantages.

T. K. Datta (2010) in "Seismic Analysis of Structures" have presented an overview of various dynamic analysis procedures for use in seismic design of structures. A discussion of the determination of the structural response to be used in association with the equivalent static force method and Response spectrum method is presented. Prashant Dhadve, Alok Rao in Assessment of "P-Delta Effect on High Rise Buildings". Increasing stiffness of building by providing suitable cross section or by increasing stiffness building by providing confinement to the structure can bring response of structure within acceptable limit.

3. METHODOLOGY

Structural systems used in today's slanted high-rise buildings

Significance of choosing the problem

According to design studies, tilted building columns affect earthquake forces. This study reveals that some slant columns of wind-prone buildings can generate large dynamic loads and govern design. This study will spark interest in oblique columns for high-rise lateral load resistance. It would highlight the importance of column inclination on high-rise structures' lateral load resistance.

- The outrigger system

Core systems with outriggers is an extension of the core system and it is very efficient for super tall and slender buildings. The central core is connected to columns located at the facade with outriggers. The outriggers can be made of steel as a truss or concrete as girders and its location determined by the designer at the places where it is needed which may be at one or more locations along the building. This way the columns at the facade get involved to resist the lateral wind or seismic loads by absorbing axial load coming from the outriggers.

- Core system with diagrid

The core system with steel diagrid is another combination in order to provide the required structural support. Diagrid system is an effective system for complex and slanted buildings because it effectively contributes to vertical and lateral loading.(SEV & TUĞRUL, 2014). An example of this system is the Capital Gate Tower, Abu Dhabi. A 164.6m high building has advantage, to be the world furthest leaning tower with 18 degree lean.

- Core system with braces

The core system in combination with braces was another system used in slanted tall buildings. The majority of the vertical load will take to the ground through the central core while the braces will take care of the horizontal forces coming from the lateral load in term of compression or tension forces. The lateral load will be resisted by the axial stiffness of the braces. There are many type of braces for example X form which is the most efficient and used shape in addition there are the K and V forms and many more.

As the lateral loads are resisted by structure with Oblique columns, the top storey displacement is very much less in Oblique structure as compared to the simple RC Frame building.

As time period is less, lesser is mass of structure and more is the stiffness. The time period is observed less in Structure with Oblique columns. This reflects more stiffness of the structure and lesser mass of structure.

Structure provides more resistance in the oblique column building which makes the structural system more effective.

4. CONCLUSIONS

- The purpose of studying different inclined Columns and compare them with designs used so far is to see how different slanted structures behave. A first approach in more complicated shapes and how they would react in different loading helped to identify the weak points of such preliminary buildings.
- The behavior of high rise building with oblique column is studied. It is studied that the oblique column system is effective in controlling drift, displacement, of the building and makes the structural form efficient under seismic loading.
- Column inclination model symmetrical to both axis shows better performance under seismic loading.
- When the height of oblique column reduces displacement and storey drift increases.

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