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Mid Rise Building having Oblique Column with and without Damper: A Review

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***Abstract:** As the modern culture of living develops, conventional regular shaped buildings are getting outdated with new designs of complex irregular shaped structures. That irregularity became the new mode of measuring the modernity and development of that society. The complex shapes demands the need of designing irregular shaped structural elements too. One of that structural elements is oblique columns. The Oblique columns are inclined or slanted or rotated at an angle to reference line. Oblique columns are stiffer and the initial stiffness of the reinforced concrete frames largely depends upon the stiffness of oblique column. For oblique column of below 90°, there will be a decrease in plan dimensions and for above 90°, there will be increase in plan dimensions as we reach upper floors. It affects the lateral stiffness of these buildings. Compared to standard columns, oblique columns of below 90° have lesser storey shear values and oblique columns of above 90° have higher storey shear values. Stiffness of reinforced concrete frames with oblique columns depends on the distribution of oblique columns. The lateral loads are resisted by structure with oblique columns of below 90°, the highest storey displacement is less in oblique structure as compared to the easy RC Frame building. The building is analyzed with and without viscous dampers. In this review paper, attempts are made to review the previous studies related to buildings with oblique columns and dampers. It aims at consolidating the outcomes of several attempted kinds of research to improve the overall stability of the buildings with oblique column.*
***Keywords:** Seismic performance, Oblique Column, Lateral Stiffness, Fluid Viscous Dampers, Response Spectrum Analysis*

I. INTRODUCTION

Nowadays population is a major problem and is increasing day by day thus resulting in construction of more vertical housing due to shortage of land. Earthquake was a common disastrous phenomenon that each and every structure on earth may suffer to certain damage. Man's search for modernism has resulted in rapidly growing construction of irregular shaped buildings. This includes addition of structural elements like oblique column. The oblique columns are not conventionally parallel or at right angles to a specified line means they're inclined or slanted or rotated at an angle. Oblique columns are stiffer as reinforced concrete (RC) frames and so the initial stiffness of the RC frames largely depends upon the stiffness of oblique column. Viscous dampers are very effective for resisting the earthquake forces. The effect of viscous dampers against earthquake loads in buildings with oblique columns is studying in project. Soil interaction with the building have an important role in resisting the earthquake load as a total. The base shear, lateral displacement, bending moments etc of the building is depending also on the properties of soil in which it is resting.

II. RESPONSE SPECTRUM ANALYSIS

The structural model can be analyzed to determine the seismically induced forces in the structures. There are different methods of analysis which provide different degrees of accuracy. The analysis process can be categorized on the basis of three factors: the type of the externally applied loads (static analysis and dynamic analysis), the behaviour of structural materials (elastic analysis and elastic plastic analysis) and the type of structural model (3D, 2D, 1D) selected. Based on the type of external action and behaviour of structure, the analysis can be further classified as linear static analysis, linear dynamic analysis, nonlinear static analysis or nonlinear dynamic analysis Response spectrum analysis (RSA) is the linear dynamic analysis to find the seismic performance of a building. This method is applicable for those structures where modes other than the fundamental one affect significantly the response of Multi-Degree-Of-Freedom (MDOF) system is expressed as the superposition of modal response, each modal response being determined from the spectral analysis of Single- Degree-Of-Freedom (SDOF) system, which are then combined to compute the total response. Modal analysis leads to the response history of the structure to a specified ground motion; however, the method is usually used in conjunction with a response spectrum.

Various studies using response spectrum analysis to find the performance of all kind of buildings under different seismic conditions are being conducted since ages. The development of high rise structures was aided by improvements in construction technology, materials, structural systems, and analytical tools for analysis and design.The lateral stability of buildings during earthquakes must be carefully considered while designing them in seismically risky areas. Diagrid (diagonal grid of columns) is a modern concept of changing the vertical orientation of column to a diagonal column. These inclined columns in the exterior surface of the buildings gives more lateral resistance against seismic forces compared to conventional building [1]. The buildings constructed on hilly slopes behave differently than that in plane grounds. The extra forces due to slope angle of the ground will affect the building adversely [2]. Shear walls are being used as a structural component as well as an earthquake resisting element. Shear wall is a load bearing concrete wall. The addition of shear wall gives more lateral resistance to the building [3]. Not every buildings can be built in symmetrical shapes. Asymmetrical buildings are built due to construction site constraints or for an unique shape to attract more people. But such building should be designed properly against the seismic forces. Even though the demand for the asymmetrical buildings are high, the symmetrical buildings shows seismic resistance during response spectrum analysis [4].The response spectrum analysis for the same building can be checked for various seismic zones, soil types using software like ETABS, SAP2000, STAAD.pro etc., in matter of minutes. The comparison of same building model in different seismic zones shows that lateral displacement are more for zone V [5].

III.OBLIQUE COLUMN

The buildings has important impact in the economic and technological strength of a country or city. Complex shaped buildings and level of high rise buildings of a region will be a topic of discussion among the enthusiasts all over the world. Buildings with oblique column is such an attention gaining structure.The oblique columns are inclined or slanted or rotated at an angle. The performance of the building will depend on the variation in the angle of oblique columns. Kai Hu, et al., in their work a high rise building located at China is studied. The main structure is a 29 storey building, including 3 floors underground and 26 floors above ground. In this study, response spectrum, time history were executed combined by software ETABS, SAP2000, MIDAS/Gen and SATWE, and results were compared [6]. Similar studies on the comparison of symmetric RCC building with and without oblique columns shows more lateral resistance against seismic forces in building having oblique column [7],[8]. the oblique column can be given to full height or partial height of the building. Each conditions behave differently according to seismic action on that building [9]. The plan dimensions of the buildings will increase as we reach upper floors for oblique column of angle above 90° and decrease for oblique column of below above 90°. Lateral loads due to earthquake can be resisted using oblique columns. The lateral displacement at top storey will be lesser for buildings with oblique column of angle below 90° and more for oblique column of above 90° [10].

IV.FLUID VISCOUS DAMPER

Fluid viscous fluid damper consists of a stainless steel piston with bronze orifice head. It is filled with silicone oil. The piston head utilizes specially shaped passages which alter the flow of the damper fluid and thus alter the resistance characteristics of the damper. Fluid damper may be designed to behave as pure energy dissipator or a spring or as a combination of the two. Shock-absorbers in car are the type of fluid damper. If the fluid is viscous, these dampers are called viscous dampers or fluid viscous dampers in which energy is absorbed by a viscous fluid compressed by a piston in a cylinder. A fluid viscous damper resembles the common shock absorber such as those found in automobiles. The piston transmits energy entering the system to the fluid in the damper, causing it to move with the damper. The movement of the fluid within the damper fluid absorbs the kinetic energy by converting it into heat. In automobiles, this means that a shock received at the wheel is damped before it reaches the passengers compartment. The construction of a fluid damper is shown in Fig.1.

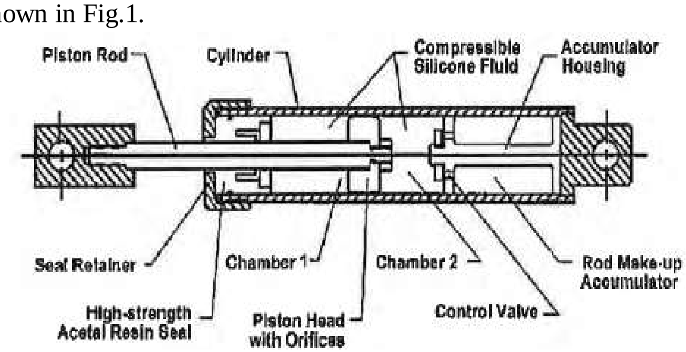

Fig. 1. Typical Viscous Fluid Damper

Buildings protected by dampers will undergo considerably less horizontal movement and damage during an earthquake.Rational location of dampers can make the stiffness and the damping of structures well distributed, and reduce seismic responses of structure effectively. In contrary, if the dampers are installed irrationally, the stiffness and the damping are not distributed well, seismic responses cannot be reduced effectively, even may be increased [11]. A simple viscous wall damper is an assembly of high viscosity fluid sandwiched between three wall plates. From the study on the effect of viscous wall dampers on reinforced concrete structures, it was found out that displacement of frames significantly reduced by using viscous dampers [12]. Study on the effectiveness of fluid viscous dampers in terms of the reduction of displacement, acceleration and shear force responses of adjacent buildings showed that placing fluid viscous dampers at selected floors will result in more efficient structural system to mitigate earthquake effects [13]. Structures like podium can have large stiffness variation. This stiffness variation creates large disturbance to the structure during earthquake. Such structure can be protected against seismic forces by adding viscous dampers into optimum positions [14]. Studies on comparing building with dampers and building with base isolators are conducted are results are compared [15].

V. CONCLUSIONS

The following are the findings of the study on mid rise building having oblique column with and without dampers. Response spectrum analysis can be done for almost all kind of buildings. Oblique column are stiffer as normal RC columns. Building with oblique column of inclination lesser than 90° shows decrease in plan area as goes to upper floors and lateral displacement for such building are lesser than that for normal column buildings. Building with oblique column of inclination more than 90° shows increase in plan area as goes to upper floors and lateral displacement for such building are more than that for normal column buildings. Fluid viscous dampers can be effectively used to decrease the seismic effect on the building. If the dampers are installed irrationally, it can cause increase in the seismic effect on the building. Optimization of damper location in building can reduce the cost of construction.

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