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Seismic Analysis of RCC Structure with Various Types of Bracing System Using ETABS for Different Seismic Zone

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Abstract
Most of the reinforced concrete building failed due to earthquake strike at that region. So it is important to choose an effective lateral load resisting system. In RCC frame, the greater importance is given to make structure safe against lateral load. To resist lateral load acting on building different types of steel and RCC bracing systems are provided. Bracing system have significant effect on performance of the structure. The use of RCC bracing has potential advantage than other bracing like steel bracing is economical, easy to erect, occupies less space, and has flexibility to design for meeting the required strength, stiffness and stability.

In present study aim to evaluate the different types of bracing system for G+4 & G+25 storey reinforced concrete building. The models were compared for different points within building such as maximum storey lateral displacement, and storey drift. The models were analyzed for different Seismic zones and medium condition soil as per IS 1893:2002 with using E-TAB software. The results of various bracing system such as X, V, Inverted V, Diagonal bracing were compared with bare frame and V, Inverted V were compared with different methods on E-TAB software. The results showed that X and Inverted V braced frames are more efficient and safe at time of earthquake.

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I. INTRODUCTION

India at present is fast developing country which requires demands in increase of infrastructure facilities along with the growth of population. Due to increased population, the demand of land for housing is increasing day by day. To fulfill the need of land for housing and other commercial offices, vertical development that is multi storey buildings are the only option. These buildings are highly susceptible to additional lateral loads due to earthquake and wind. In broad, as the elevation of building increases, its reaction to lateral loads increases. Reinforced concrete buildings are vulnerable to excessive deformation, which necessitate the introduction ofspecial measures to decrease this deformation. Steel braced frame is one of the lateral load opposing frameworks in multi storey structures. Steel bracing system enhances the resisting the structure against horizontal forces by expanding its stiffness and stability. Bracings holds the structure stable by exchanging the horizontal loads for example, earthquake or wind burdens down to the ground and oppose side long loads, in that way keep the influence of the structure. Steel bracing members in RC building in conservative, simple to setup, involve less space and give obliged quality and inflexibility. A braced frame in astructural system which is designed primarily to resist wind and earthquake forces.Bracing resist the lateral load by bracing action of inclined members.They stimulate forces in the associated beam and columns such that the whole work like a truss subjected to axial stess.This axial stess reduces the which in turns results in the reduced section of the column. Bracing members are arranged in so many forms, which carry solely tension ,alternatively tension and compression.The bracing is made of crossed diagonals , when it is designed to resist only tension . based on the direction of wind,one diagonal takes all the tension while the other diagonal is assumed to remain inactive.One of the most common arrangenment is the cross bracing. There are other types of bracing systems like V and inverted V type bracing. Braced frame provide resistance to lateral force by there bracing action. The braces simulate force in the associated beams and columns, so that all work together as one like truss member. Abracing system improves the seismic performance of the frame by increasing its stiffness and capacity. The bracings hold the structure stable by transferring the loads sideways (not gravity,the wind or earthquake loads) down to the ground,there by preventing sway of the structure.

II. LITERATURE REVIEW

A. Kadid, D. Yahiaoui etl(2011), "Seismic assessment of braced RC frames.",pg. no. 2899-2905, vol. 14, June 2011Recent earthquakes in Turkey (1999), Taiwan (1999) and Algeria (2003) demonstrated the catastrophic impact of such power upon urban cities. A great number of existing buildings in Algeria designed without seismic design criteria and detailing rules for dissipative structural behavior suffered damages which were far worse than that for newer buildings designed and built according to the more stringent seismic code rules. Thus, it is of critical importance that the structures that need seismic retrofitting are correctly identified, and an optimal retrofitting is conducted in a cost effective fashion. Among the retrofitting techniques available, steel braces can be considered as one of the most efficient solution for seismic performance upgrading of RC frame structures. This paper investigates the seismic behavior of RC buildings strengthened with different types of steel braces, X-braced, inverted V braced, ZX braced, and Zipper braced. Static nonlinear pushover analysis has been conducted to estimate the capacity of three story and six story buildings with different brace-frame systems and different cross sections for the braces. It is found that adding braces enhances the global capacity of the buildings in terms of strength, deformation and ductility compared to the case with no bracing, and the X and Zipper bracing systems performed better depending on the type and size of the cross section.

1. **Bharat Patel, Rohan Mali, G. Mohan Ganesh etl(2017), "Seismic behavior of different bracing in high rise RCC buildings."** pg. no. 973-981, vol. 8(3), March 2017. The high-rise buildings that were made of RCC frame, the greater importance was given to make structure safe against lateral load. These loads were produced due to wind, earthquakes etc. To resist lateral load acting on building different types of steel or RCC bracing systems were provided. The use of RCC bracing has potential advantage than other bracing like higher stiffness and stability. This study aimed the comparison of different RCC bracing system under seismic behavior in high rise buildings. Also three structural configurations used in this paper are Moment Resisting Frames (MRFs), X-BracedFrames
(XBFs), V-Braced Frames (VBFs) for 11 storey (G+10) building. The bracing systems provided on periphery of the column. The frame models are analyzedas per IS: 1893-2000 using STADD.ProV8i and ETABs software's. The parameters which were considered in this paper for comparing seismic effect of buildings were base shear and storey displacement. The results showed that X-braced frames are more efficient and safe at time of earthquake when compared with moment resisting frames and V-braced frames.

2. **Sagar T. Kawale, D. H. Tupe, G. R. Gandhe etl(2019), "Seismic analysis of steel frame building using bracing in E-Tab software."**, pg. no. 1292-1295, vol. 06(12), Dec 2019This paper compares seismic analysis of G+11 square building and L shaped building by using time history analysis in ETAB 17.01 software also compare displacement, base shear and pseudo acceleration and used different types of bracing systems and conclude which type of building and which type of bracing gives minimum displacement, base shear and pseudo acceleration.

3. **Dhiraj Naxine, Prof. R.V.R.K Prasad etl(2016), "Comparative study in the analysis of multistorey RCC structure by using different types of concentric bracing system.",**pg. no. 432-433, vol. 1(6), Jun 2016 From last some years we had seen that the most of the RCC buildings were failed due to lateral load. Bracings systems were one of the lateral load resisting systems which had got structural importance especially in reinforced concrete buildings. Different bracing systems were efficient enough for seismic responses. Steel bracing systems had both practical and economic advantages. The application of steel bracings was faster to execute. The steel bracings are usually installed between existing vertical members. The purpose of the study of seismic response of a building is to design and build a structure in which the damage to the structure and its structure component by earthquake is minimized. The paper aimed towards the review of study of analysis of Unbraced and braced multistorey RCC building conducted by various authors in the past.

Objectives:
1. To study (G+4 and G+25) building with and without bracing by usingE-tab.
2. To study X, V, inverted V and diagonal bracing system by using E-tabsoftware.
3. To compare the response of different braced and unbraced building subjected to lateral loads.
4. To identify the suitable bracing system to resist the lateral loads effectively.

Scope of the projectwork:

The main aim of this project is to study the seismic analysis of RCC structure with varioustypes of bracing system. The study has done on 5 different models of G+4 and G+25 storey building in E- Tab software. We applied various types of bracings such as X, V, Inverted V and diagonal to the model and analyzed them. Thedisplacements results are compared between unbraced and braced model and identified thesuitable bracing system for RCC structure.

III. METHODOLOGY:

Seismic analysis is a subset of structural analysis and is the calculation of the response of a building (or non-building) structure to earthquakes. It is part of the process of structural design, earthquake engineering or structural assessment and retrofit in regions where earthquakesare prevalent. In this chapter detailed methodology of seismic analysis and description of analyzing building is explained.

Limitation of study:

1. Altitude-dependent changes in seismic region.
2. The length of the span is usually restricted to the 40 feet when reinforced.

Expected outcome:

1. By addition of bracings to the building storey responses like displacement, drift can be reduced**.**
2. Concept of using bracing is advantageous to resist the seismic forces.
3. After using bracing member as a resistive member margin of safety against collapse increased.

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