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Analysis of irregular connected twin buildings subjected to seismic loading

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Abstract - *Irregular twin buildings have more sensitive to Seseimic loading because of reentrant corners [3][1][7]. So we need to study on different parameters which will reduce the effect of Seseimic loading [2]. So in this research by structural connection we tried to reduce the effect [10]. Different parameters are taken into consideration for analysis [5].*

***Key Words*: Story drift, Story displacement, Max. Displacement, Story response, Response spectrum method, Etabs**

1. INTRODUCTION

The seismic design of normal buildings is predicated on two concepts. Firstly, the linearly varying lateral force distribution could be a reasonable and conservative representation of the particular response distribution because of earthquake ground motions [4]. Secondly, the cyclic inelastic deformation demands are reasonably uniform because of the seismic force–resisting elements. However, when a structure has irregularities, these concepts might not be valid, requiring corrective factors and procedures to fulfil the planning objectives.

The shapes and irregularities of the building have a serious effect on the distribution of earthquake forces as they work their way through the building [9]. Geometric configuration, details of connections, materials of construction, and structural members, all have a profound effect on the structural-dynamic response of a building. When a building has irregular features, like vertical discontinuity or asymmetry in plan, the assumptions applied in developing seismic criteria for buildings with regular features might not apply[6].Therefore, it's best to avoid creating buildings with irregular features. But irregular buildings have become unavoidable a part of our life. When irregular features are unavoidable, special design considerations are required [8] to account for the weird dynamic characteristics and also the load transfer and stress concentrations that occur at abrupt changes in structural resistance.

2. LITERATURE REVIEW

1) S. Boopathi Raja V. Preetha

The study summarizes various sorts of structural irregularities i.e. Plan and vertical irregularities in RC building together with their performance during earthquake.

2) Vedantee Prasad Shukla Shukla, Sayali Pradeep Rote, Manoj Bharat Kamble

In this paper static analysis is performed for R.C.C frame regular and irregular G+ 15 story building by using "Response Spectrum Method". The issues introduced because of discontinuity in stiffness, mass and geometry of structure. IS codes are to be used for design of different civil engineering structures and their specification. These elements are designed by using software ETABS. And consider seismic load and wind load. For load combination IS 1893:2002 used. Irregular building is compared to four zones.

3) Shehata E. Abdel Raheem[1'2] Momen M. M. Ahmed[2]

The focus of this study is to analyze structural seismic response demands for the class of L-shaped buildings through evaluating the plan configuration irregularity of re-entrant corners and lateral–torsion coupling effects on measured seismic response demands. The measured responses include over building height, story shear force, overturning moment, story drift, torsion moment at the bottom and torsional irregularity ratio, and inter-story drift.

4) Bharat Khanal, Hemchandra Chaulagain

This study measures the effect of plan configuration irregularity when subjected to the Changing angle of the input response spectrum. For this, 1 regular and 6 different L-shaped RC building frame was modelled for numerical analysis. The analysis was done through static lateral force method and response spectrometry (dynamic analysis). The structural responses were considered in terms of overturning moment, inter-story drift ratio, normalized base shear force, torsion irregularity ratio, torsion diaphragm rotation, and story displacement. The results show that buildings with plan configuration irregularity are more sensitive to the varying angle of the input response spectrum as compared to the symmetrical building model. The huge increase in seismic response demand was observed when the finite element models were subjected to a 135 degree angle as compared to the 0º angle of seismic incidence.

5) Rohan Chavan[1], Prachi Sohoni[2]

In proposed problem G+11 story irregular RC buildings are analysed with and without cross bracing system, which is among the best of concentric bracing systems. Non-linear time history analysis is carried out in order to seek response of structure for various ground motions. ETABS 2016 software is

employed for analysis purpose. The performance of the building is measured in terms of base shear, bending moments, lateral displacements, axial forces and story drifts.

6) Jayant Shaligram[1] Dr. K.B Parikh[2]

The study looks for the performance of the setback building with open ground storey using nonlinear static pushover analysis. Such type of building possesses vertical geometric and mass irregularity as well as stiffness irregularity. In this plan irregular setback building with open ground storey placing on plain and sloping ground which makes the building so feeble to survive an earthquake. Attempt has made to reduce effects of these irregularities during an earthquake by replacing OGS columns by Reinforced concrete filled steel tube columns. RCFST columns increase the stiffness of the OGS which offset the soft storey effect as well as reduce storey displacement, drift and torsional response significantly. Hinges results, shows us that performance of the building is improved significantly.

Ref. Emerging Research and Innovations in Civil Engineering

7) Mohammed Mohi uddin[1],Hashim Mohiuddin[2]

In the present work, an analytical study is performed to evaluate the effect of plan irregularity on the seismic behaviour of the conventional RC framed building. Six models of G+14 storey building with one regular and remaining irregular plan (Hexagonal, Circular, Elliptical, Sector and Y-shape) have been taken. The Plan area for each structure is same. The performance of these models under Seismic loading is checked by carrying out Response Spectrum analysis taking help of structural analysis software ETABS 2016 v16.2.1. The comparison is made between the Irregular model and regular model for various parameters.

8) Surendra Chaurasiya1, Sagar Jamle2

A lot of twin towers are under construction not only in India but also across the world. These structures are made by bridging the gap between these two towers by different means like steel connections, making the bridge or by RCC frame, etc. In this various papers are studied to optimize the need and comprehend the concept. The study on various research papers also with existing towers helps in deciding the objectives of the study and also the optimizing parameters.

9) M.R. Willford[1]and R.J. Smith[2]

This paper suggests the structural design of two similar 60 storey towers in Manila using performance based procedures for wind and seismic actions. High-rise buildings designed with performance based methods not only perform better than conventionally designed ones, but are also less costly to construct. The buildings incorporate the Arup Damped Outrigger System, and the savings realized by this are discussed.

10) Imad Shakir Abbood * ahir Mahmod Ammar N. Hanoon Mohd Saleh Jaafar Mohamed H. Mussa

Outcome of structural links on seismic responses for a linked building system has been checked in this paper by using finite element modelling technique. Linked building system in this is displayed by twin 40-story reinforced concrete frame-wall structures horizontally coupled with structural links. It is assumed that the 2 adjacent buildings were similar so the two adjacent stories can be linked at the same height by an inter-building link. The linked building system is modelled as rigid floor diaphragm for towers and as a beam for each link fixedly linked to the perimeter structural framework of the buildings. By employing earthquake time history excitation, the seismic responses of the twin towers were computed at various locations for the link. The responses of structures were evaluated and compared. The analysis outcomes shows that the link can effectively change the structural responses of the linked building system. The structural responses have been alleviated in some cases in comparison to the single tower, referring to the extra link stiffness as getting the single tower to withstand seismic excitation while the responses have been improved in other cases, attributing to the addition in mass of link. Hence, in the design of seismic-resistant linked building systems, utmost care must be taken, mostly regarding properties of the link, specifically mass, location and stiffness, also the link resistance with respect to the strength of the link and the structural elements having the link to obviate undesired structural responses.

Methodology

Response spectrum analysis

In the response spectrum method of analysis, multiple modes of vibrations were used in the frequency domain. The response of a multi-storey structure is defined as a combination of various special modes i.e. in a vibrating string corresponds to the “harmonics". The computer program is used to determine this special mode of structure. For each mode, are response is recorded from the design response spectrum, base modal mass and the modal frequency; they are then combined to estimate the total response of the structure.

PROBLEM STATEMENT

During this proposed work, are going be analyzing irregular twin building on various parameters of Seismic loading. And also provided connection at different positions to test the behavior of the structure under Seismic loading and also conclude the effectiveness of the connection at specific position.

Table -1: Building data

Building configuration	G + 12 (C shaped)
No. of bays in X direction	4
No. of bays in Y direction	5
Height of building	39 m
Dimensions of building	15 m x 12 m

1.2 OBJECTIVES

1. To investigation the behavior of RCC irregular twin building with structural connection at top and middle of the elevation and without structural connection.
2. To make a location more suitable to resist horizontal loading i.e. Seseimic loading.

MODELLING

The space frame will model in ETABS software. The descriptions of the twin buildings are listed in Table 1.Various connecting locations will be studied up to 12 floors. The performance of the building will evaluate in terms of story drifts, and max. Displacement.

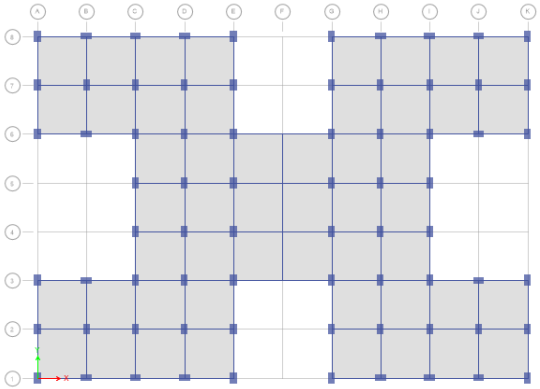


Fig1: **Plan View of with Top connection**

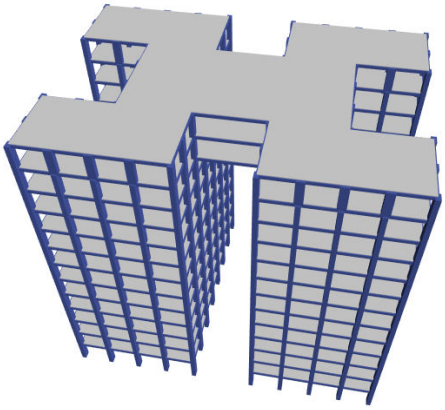


Fig2: 3D View with Top connection

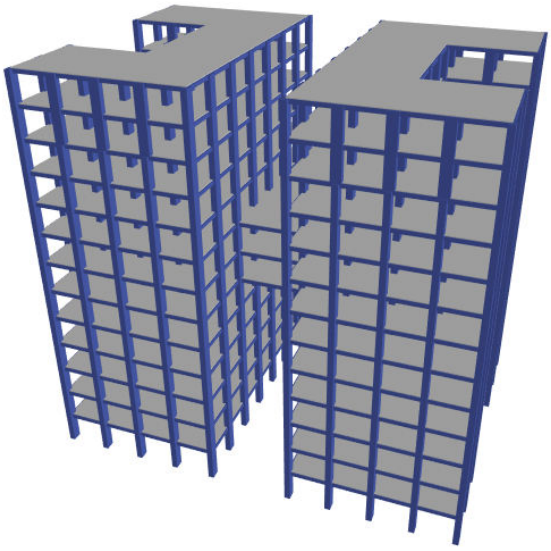


Fig3: **3D View with middle connection**

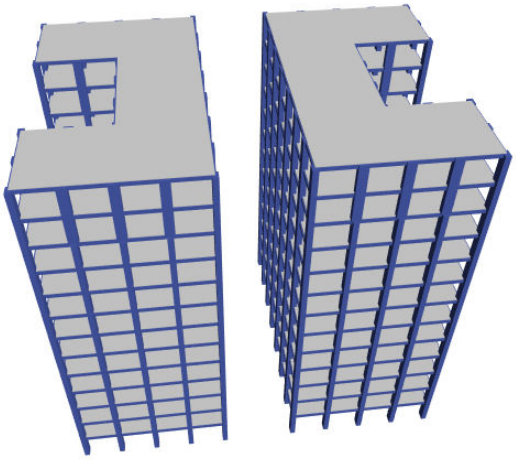
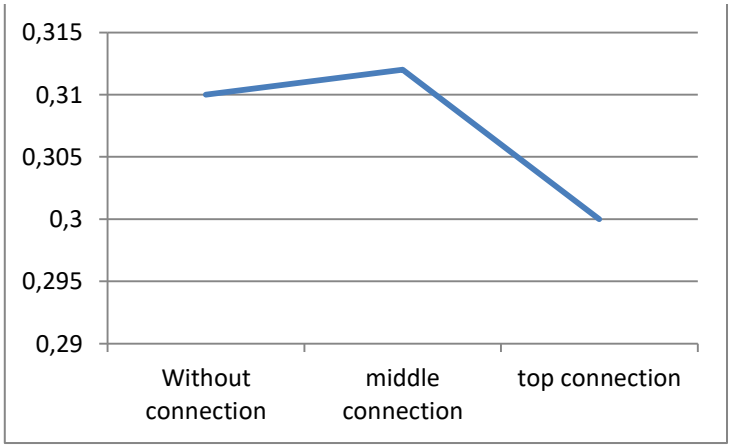


Fig4: **3D View with middle connection**

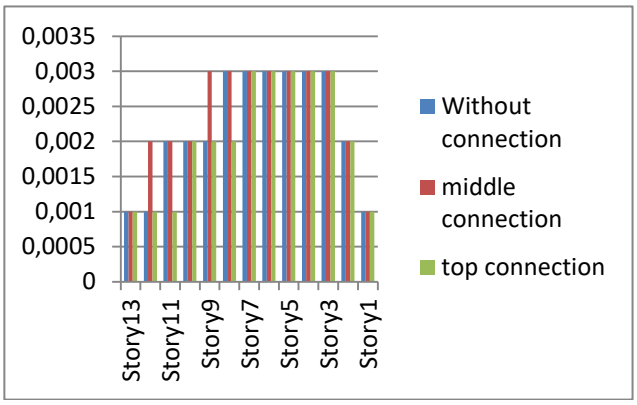
ANALYSIS & DISCUSSION OF RESULTS

Analysis is done using Etabs software for zone V and soil type as 2.

Max. Storey displacement of building with and without connection:



Graph 1: Graph of Max story displacement



Graph 2: Story drift

3. CONCLUSIONS

Based on the results and discussion given in chapter 5 the following conclusions are drawn.

- It is concluded that story drift is comparatively less in top connection and without connection as compared to middle structural connection. So, when earthquake occurs it provides more stability to the building.
- Top connection is more effective than middle connection as story drift is less as compared to middle connection.
- From the storey response we also concluded displacement of middle building connection is more as compared to top connection.
- From all three buildings Irregular twin building with top connection is more effective on Seseimic loading.

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