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A Review on Seismic Behavior of Irregular Building Due To Position of Shear Wall

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Abstract:

Shear wall is a vital part of a high rise building. The main reason behind this is - shear wall induces lateral stiffness to the high rise building. The lateral stiffness of the building is responsible for the strength of the building against lateral force, e.g. – Earthquake, Wind Forces. In this paper, a review is made on the literatures which are related to the functioning of shear wall. The functioning of shear wall is greatly defined by its location in the building. The paper presents a review on various literatures related to the location of shear wall which is in a way, responsible for the functioning of shear wall.

Keywords – **Shear Wall, Dynamic Analysis, Response Spectrum Analysis, Time History Analysis**

I. INTRODUCTION

Fig. 1 Shear Wall in Building

Shear wall is a very important element as it provides lateral stiffness to the high rise building. Lateral stiffness is that property of a high rise building which is responsible for resisting the lateral forces like earthquake, wind etc. The lateral stiffness depends on the location of the shear wall in a building at a great extent. Although not only location but other factors like thickness and shape are also some of the important determining factors for defining the efficiency of shear wall against the lateral forces. But the major factor is the location of shear wall in the building. In the paper, the following section elaborates various points related to functioning of shear wall which are stated by various authors.

II. REVIEW OF LITERATURE

A. Mario De Stefano & Barbara Pintucchi (2007)

The paper presents an overview of the progress in research regarding seismic response of plan and vertically irregular building structures. Three areas of research are surveyed. The first is the study of the effects of plan-irregularity by means of single-storey

and multi-storey building models. The second area encompasses passive control as a strategy to mitigate torsional effects, by means of base isolation and other types of devices. Lastly, the third area concerns vertically irregular structures and setback buildings. Although fewer papers have been published in this last area with respect to the former ones, this state of the art reports extensively on research efforts and progress into the seismic behavior of irregular buildings in elevation to show the growing interest among specialists in the field.

B. Bulent Erkmen & Arturo E. Schultzself (2009)

Centering ability of unbonded post-tensioned precast concrete shear walls has been attributed to the presence of post tensioning force. However, the experimental results presented in this paper indicate that the post-tensioning force may completely die out during cyclic loading while the walls are able to retain their superior self-centering characteristic. Moreover, the analytical study presented in this article indicates that with proper configuration of end-anchorages for post-tensioned tendons, self centering of post-tensioned walls can be achieved even when the post-tensioning force vanishes. This study also investigates the effects of tendon layout, tendon end-anchorage configuration, and external vertical load on the self-centering ability of unbounded precast concrete shear walls subjected to earthquake loading.

C. R.S. Malik, S.K. Madan, V.K. Sehgal (2011)

In this paper, the use of shear wall which certain curtailment has been discussed. For the comparison, three buildings of height 10, 20, 30 are compared with curtailment at various hieghts. The results showed that, the curtailment posterior wall up to 50% height of the building as a marginal effect on distribution of horizontal story shear wall frames and interior frames. But the height of the building a significant role in storage share distribution.

D. Romy Mohan & C Prabha (2011)

As the world move towards the implementation of Performance Based Engineering philosophies in seismic design of Civil Engineering structures, new seismic design provisions require Structural Engineers to perform both linear and nonlinear analyses for the design of structures. While Linear Equivalent Static Analysis is performed for regular buildings up to 90m height in zone I and II, Dynamic Analysis should be performed for regular and irregular buildings in zone IV and V. Dynamic Analysis can take the form of a full nonlinear dynamic Time History Analysis or of a linear Response Spectrum Analysis. In present work, two multi storey buildings, one of six and other of eleven storeys have been modeled using software package SAP 2000 version 12 for earthquake zone V in India. Six different types of shear walls with its variation in shape are considered for studying their effectiveness in resisting lateral forces. The paper also deals with the effect of the variation of the building height on the structural response of the shear wall. Dynamic responses under prominent earthquake, El-Centro have been investigated. This paper highlights the accuracy and exactness of Time History analysis in comparison with the most commonly adopted Response Spectrum Analysis and Equivalent Static Analysis.

E. Ashish S. Agrawal & S. D. Charkha (2012)

RC multi-storey buildings are adequate for resisting both the vertical and horizontal load. When such building is designed without shear wall , beam and column sizes are quite heavy and there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these places and displacement is quite heavy which induces heavy forces in member. Shear wall may become imperative from the point of view of economy and control of lateral deflection. In RC multi-storey building lift well or shear wall are usual requirement. Centre of mass and stiffness of the building is ideal for a structure. However, on many occasions the design has to be

based on the off centre position of lift and stair case wall with respect to centre of mass which results into an excessive forces in most of the structural members, unwanted torsional moment and deflection. Incorporation of shear wall has become inevitable in multi-storey building to resist lateral forces .It is very necessary to determine effective, efficient and ideal location of shear wall. In this paper, study of 25 storeys building in zone V is presented with some preliminary investigation which is analyzed by changing various position of shear wall with different shapes for determining parameters like storey drift, axial load and displacement. This analysis is done by using standard package ETAB.

F. Wakchaure M.R, Ped S. P (2012)

In this paper the effects of masonry infill panels on the response of RC frame structures is been presented. Infill behaves like compression strut between column and beamand compression forces are transferred from one node to another. For the analysis of G+ 9 RCC framed building is modelled. The analysis is done in ETABS. The comparison of base share, story drift, story displacement is done. the result show that infield was reduced displacement, time period and increases base shear.

G. Ehsan Salimi Firozabad, Dr. K. Rama Mohan Rao, Bahadir Baheri (2012)

In this paper, comparative study of buildings which shear wall under seismic loading is done. the comparison of dynamic behaviour of the building is carried out in the software package like SAP 2000. The buildings have a certain configuration of the shear wall and the comparison was done to obtain the optimum configuration shear wall in the multi storey building.

H. P.P. Chandurkar, Dr. P.S. Pajgade (2013)

In this paper, a comparative study is been done with for buildings with and without shear walls. This was a regular building which certain positions of share wall and the analysis of various responses were carried out for determining the optimum position of shear in the regular building. The software package was ETABS for analysis and comparison.

I. Varsha R. Harne (2014)

Shear wall systems are one of the most commonly used lateral load resisting systems in high-rise buildings. Shear walls have very high in plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. There are lots of literatures available to design and analyze the shear wall. However, the decision about the location of shear wall in multistory building is not much discussed in any literatures. In this paper, therefore, main focus is to determine the solution for shear wall location in multistory building. A RCC building of six storey placed in NAGPUR subjected to earthquake loading in zone-II is considered. An earthquake load is calculated by seismic coefficient method using IS 1893 (PART–I):2002. These analyses were performed using STAAD Pro. A study has been carried out to determine the strength of RC shear wall of a multistoried building by changing shear wall location. Three different cases of shear wall position for a 6 storey building have been analyzed.

J. J.V. Sunil Ganesh, Mallikarjun S. Bhadiwad (2014)

In this paper, the authors have discussed the significance of shear wall in a building. Shear wall acts as a major earthquake resisting member and simultaneously resists the gravity loads. In this study a 20 story a regular building in zone 5 is presented. In which same shear wall with same cross section area is considered which is analysed by changing the various locations to find the optimum position of shear wall. The parameters like story drift, story displacement, spectral acceleration, etc are compared. The use of standard FM softwares like ETABS has been done for the comparison.

K. M.S. Ainawala, Dr. P.S. Pajgade (2014)

In this paper, a comparative study is been then for analysing the seismic effect on multi storey buildings in seismic zone 2 3 4 and 5 with and without shear walls. ETABS was used as the software for analysis of the buildings. It was found that building with shear wall is more economical than the buildings without it.

L. Mohamed A. Dahesh, Ahmet Tuken, Nadeem A. Siddiqui (2014)

In this paper, a parametric study of shear wall in a building is done. For the study, shear walls of various thickness are considered, analysed and compared. The building was having a dual system and and also various positions of shear wall. This always being compared and and optimum position and thickness were decided.

M. K. Lovaraju & K. V.G. D Balaji (2015)

In this paper the focus is to identify effective location of shear wall in multi storey building. An earthquake load is applied to a building of eight storey is located in zone-2, zone-3, zone-4, and zone-5 with different location of shear wall as per code provision IS 1893-2002. The analysis has been carried out using ETABS software. It was concluded that provision of shear wall influences the seismic performance of the structure with reference to strength and lateral displacement Shear wall in position-3 performs better with reference to lateral displacement and it reduces 26.7% when compared to the frame without shear wall. The provision of shear wall position and appropriate location is advantageous and the structure performs better for an existing and new structure.

N. S K Hirde, N K Shelar (2015)

In this paper, a G+6 story building is considered. The building is a regular shaped and comparison is made for the effective position of shear wall in building which is located at plain ground and at sloping ground. The paper clearly elaborates about the Dynamic Analysis of the building. The comparison was done for Base Shear, Torsion, Floor Displacement, etc. It was found that the base shear and torsion were increased at the sloping ground. For the analysis by Response Spectrum Method, SAP 2000 was used.

O. Gourav Sachdeva, Rajesh Jain, Rajeev Chandak (2015)

In this paper, a G+5 storey building is considered for studying the effectiveness of position of shear wall in the building. STADD Pro was used as a software package for the calculation of following – Reinforcement percentage, Storey Drift, Maximum Shear Force and Bending Moment, etc. The shear wall configuration which most effective was the one which distributed both the mass and stiffness in a uniform manner. This was compared by the results of the analysis.

P. S Sangeetha, G C Shivanand (2016)

In this paper, an attempt is made to study the dynamic behavior of the structure with vertical irregularity i.e. soft story effect. To eliminate the soft stories, masonry infill walls are used and also been tried to investigate the behavior of this system by considering the wall opening in the infill masonry unit. The paper deals with analytical study of the Stiffness Irregularity. For the analysis, a G+34 storey building is considered for the analysis purpose. Dynamic Analysis is carried out by Response Spectrum Method by using ETABS version 15.2. It was found that, the model with open ground floor is having more displacement as compared the soft stories placed at other levels. Thus, the failure of open ground floor buildings is more during earth's shaking.

Q. Rupali Goud, Sumit Pahwa (2016)

In this paper, the authors elaborate about the feasibility related to shear wall in building. They have described about the location of lift core in a building. As the multistoried building consists of lift core which are generally shear wall. Thus if they

provided at suitable location, the use of extra shear walls can be minimized.

R. D Vivek Varam, C.H. Vinodh Kumar, K V Vijaya Kumarraju (2017)

In this paper, a G+10 storey building is considered and determination of suitable position of shear wall is carried out by checking parameters like – nodal displacement, base shear, steel quantities, etc. The paper also describes about the cause of earthquake and apart from that, it clearly explains the Response Spectrum Method in analysis of building subjected to seismic loads.

S. Abhija Mohan, Arathi S (2017)

In this paper, a comparison is carried out for determining the effectiveness of shear wall with vertical and staggered opening. For this, both regular and irregular shaped buildings are considered. The effectiveness is defined from analyzing the results of base shear and storey displacement from various configurations of the shear wall. It was found that shear wall with staggered opening was more effective as compared to the walls with vertical opening.

T. Poornima D, Sanjay S J, Yajnodbhavi H M (2017)

This paper explains about various lateral load resisting systems as per Indian Standards. An L-Shaped Buildings is considered for comparison with a regular building. Various configuration of shear wall is considered for both regular and irregular shaped buildings and best configuration is defined by storey drift, storey displacement and base shear.

U. Lakshmi K O, Prof. Jayasree Ramanujan, Mrs. Bindu Sunil, Dr. Laju Kottallil, Prof. Mercy Jospeh Poweth (2017)

This is a well described paper which deals with the determination of behavior of a building with respect to the position of shear wall. In this paper, the authors have described the following topics - seismic resistant of buildings, equivalent static method, non linear pushover analysis, capacity – demand curve, methods of dynamic analysis. Eight models of multi-storey buildings are considered with various configurations of shear wall. These models are checked for the following behaviors – Storey Drift, Base Shear, Lateral Displacement, Reinforcement Demands in Columns, Plastic Hinge Locations. On a conclude note, it was found that the steel requirement was reduced to 44.6% when shear wall is provided at the core and 34.7% when shear wall is provided at the corner of the structure. Apart from that, it was also found that Push-Over Analysis provides an insight into the performance of the structure in post elastic range which thereby helps in assessing the weakness and possible failure mechanism of structure which is not possible when using equivalent static and response spectrum method of analysis.

V. Ozem Cavdar, Ahmet Cavdar and Ender Bayraktar (2018)

In this paper, performance based structural design is used to determine the expected performance level of structures under earthquake effect. In performance based design, it is expected that more than one damage level can emerge under one earthquake effect. In this study, the seismic behavior of shear wall building that collapsed during the 2003 Bingol Earthquake was investigated by non linear static and dynamic analysis. The performance goals of reinforced concrete shear wall were evaluated by applying Pushover Analysis. In the study, the building which is considered wall collapsed in the earthquake and the analysis was done as per Turkish Code. From the analysis, it was that the buildings was far from satisfying the performance level and apart from that, the results of pushover analysis show lower damage ration of upper storey beams than those from non linear dynamic analysis.

III. INFERENCE

After going through the above literatures, it is found that position of shear wall plays an important role in defining the behavior of building against lateral loads. To be more specific, the secret lies in the

distribution of stiffness and mass of the structure which is governed by the location of shear wall. Thus, the entire optimum configuration which was obtained in the above papers was providing the best distribution of stiffness and mass. If this is done, the various consequences like storey drift, displacement, base shear, etc. can be controlled at a greater extent.

IV. CONCLUSION

After reading the above research papers, it is found that lot of work is done in determining the position of shear wall in regular buildings. But, the input data or the test models for the comparison are very less and the calculations are very simple. In this manner, we are far away from the real challenges. In order to find the optimum position of shear wall, sufficient input data is required in form of test models. Apart from that, the surrounding condition should also be varied to obtain a relevant result. Thus, in order to analyze the high rise building for determining the seismic behavior, one has to use more input data and more varying surrounding conditions. This will give more precise results unlike some of the above papers.

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