International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Torsional Effect on Multi-Storeyed Building on Regular and Irregular Shape of Building with and without Infill by Using P-Delta Analysis

Shaikh Salman[1], D. H. Tupe[2], Dr. G. R. Gandhe[3]

[1]P.G. Student, Civil Engineering Department, Deogiri Institute of Engineering and Management Studies, Aurangabad-431001, Maharashtra, India

[2]Professor, Principal Guide, Department of Civil Engg., Deogiri Institute of Engineering and Management studies, Aurangabad-431001, Maharashtra, India

[3]Head of Department, Department of Civil Engg., Deogiri Institute of Engineering and Management studies, Aurangabad-431001, Maharashtra, India

Abstract: ***Torsional effect on structure is the modified seismic response of building which caused several damages or collapse of structure. P-Delta effect are the second order effects which increase lateral displacement in which the lateral displacement can be caused by wind or seismically induced inertial forces in the high rise structure. The increase in number of storey in the structure directly proportion to the delta effect in the structure. The present work concerned with the Comparative Study On Behaviour of Torsional effect on multi-storeyed building on regular and irresgular shape of building with and without infill on High Rise structure With consideration of Non-linear P-Delta Analysis. The present paper shows the study overview of different research works to be done in high rise structure for analysing the torsional effect on structure by using P-Delta analysis.***

Keywords: High rise RC.C. structure, torsional effect analysis, structure with and without infill, Regular and irregular shape of structure, non-linear P-Delta analysis. ETABS

1. Introduction

Now a days frame structures Reinforced concrete (RC) and Steel with masonry infills are commonly used everywhere, including the regions of high seismicity or low seismicity. Infilled frame structures have been used for low and high rise buildings. On considering the torsional effect on structure on regular and irregular shape structure it shows lateral displacement of floor diaphragms are rigid in their own plan in relation to the vertical structural elements that resist the lateral forces. Torsional irregularity to be considered to exist when the maximum storey drift, computed with design eccentricity, at one end of the structures transverse to an axis is more than 1.2 times the average of the storey drifts at the two ends of the structure. Limitation of the area for constructions work of domestic buildings of structure and high cost of available land, the high rise structures of regular and irregular structure are preferable now a days. As the increase in the height of the structure then increasing in lateral load. For the lateral load resisting structures become very important than the structures that resist the gravitational loads.. The seismic performance of such structural systems is an important aspect for the structure specially by using P-delta analysis to maintain its seismic safety when it exposes to earthquake events on any structure. The main benefits from the use of high rise composite R.C.C. structures construction are in terms of construction time and cost.

2. Literature View

Romanbabu M. Oinam, *et al* [1] They studied the three geometrically similar frames, having different configurations of masonry in fills, has been investigated. The frames have been modelled in *OpenSees* simulation platform, utilising material and section properties available in its library. This paper mainly focuses on studying the effect of masonry infills in the RC frames and its hysteretic response during an earthquake event, where it is expected to go into the non-linear range. Static non-linear cyclic pushover analysis has been carried out to predict the seismic performance of the study frames. All the frames started yielding from 0.75% drift level. The bare frame and open ground frame started showing load degradation after 2.75% drift level, while fully infilled frame started degrading after 3.5% drift level. Overall performance of fully infilled frame is far better than that of the bare frame and open ground frame.

Sanaa Elmalyh, *et al* [2] They studied about earthquake, infill walls have significantly negative effect on concrete frame, e.g.: soft-storey, short column due to partial infills, torsional effects due to irregular and unsystematic placement infills and out-of-plane collapse. however, their influence still not taken in consideration, therefore, it is very important to define the behaviour of the infill panels in the seismic response. reinforced concrete frames are being used in buildings with infill panels which are generally not considered when analyzing the seismic effects, the fact that infill panels were not covered in the design stage and also in analysis had led to a significant damage, e.g.: A l-Hoceima in Morocco - L'Asnam in Algeria and Pam in Iran. The interaction between frames and masonry infill panels in the seismic analysis becomes vital to prevent such damages, however, these infill panels are not considered as structural elements in structural analysis, even if they have a great contribution on the structural properties (stiffness, strength, ductility, energy dissipation capacity).

Our study based on that, to review the various approaches used for the analysis of infilled frame structures and to present a literature review of different researches, especially those working on evaluating the diverse results associated with: modelling different types of structures, reasons of fissure appearance in structural element caused by infill walls, the evaluation of results and the study of the structures due to effect of dynamic load. Our research will focus on the modelling of panels in order to predict a more realistic response of buildings to seismic actions.

Hemant B. Kaushik, *et al* [3] They studied behaviour of eleven half-scale, single-story masonry infilled reinforced concrete (RC) frames under slow cyclic in-plane lateral loading was experimentally studied in two stages. Results obtained in the first stage (eight frames) showed that the frames infilled with full-scale and half-scale bricks exhibited higher strength, stiffness, and energy dissipation than their bare frame counterparts. In most cases, columns failed in shear even though the masonry used was quite weak. In order to delay the shear failure in columns, shear design of columns was enhanced as per the existing earthquake standards, and tests were repeated on three improved frames in the second stage. Though shear failure in columns of the improved frames occurred at higher drift level, the shear failure in columns could not be prevented showing the inadequacy of current design codes. Based on the experimental results, an idealized load–displacement relationship for masonry infilled RC frames was developed for different performance levels.

The lateral load resistance is mostly dominated by shear behaviour of columns when the strength and stiffness of infill is sufficiently large, local detrimental effect of infill may cause shear failure of columns. it was observed that there are several factors that had significant influence on failure mechanism of masonry infilled RC frames, which include aspect ratio, openings in the infill panels, column to beam stiffness ratio, axial load ratio on columns, type of infill and the construction methodology, number of stories and bays, it was reported that the frame failure mode, associated with weak frame-strong infill configuration. infilled frames need to be designed to resist the excessive shear force from infill Seismic design codes of many countries neglect the contribution of masonry infills in lateral load resistance and design RC frames as bare frames. On the other hand, a few national codes (IS 13920, Eurocode 8, and ASCE 41) have specific provisions for design and detailing of columns in such buildings.

Mohaiminul Haque, *et al* [4] They studied about that the Bangladesh is one of the most earthquake prone areas in South-Asia and Sylhet is the most seismic vulnerable region in Bangladesh. Seismic performance analysis is highly recommended to ensure safe and sound building structures for this region. For effective performance of reinforced concrete (RCC) structure, new seismic design provisions require structural engineers to perform both static and dynamic analysis for the design of structures. The objective of the this study is to carry out static and dynamic analysis i.e. response spectrum analysis (RSA) and time history analysis (THA) for different regular and irregular shaped RCC building frames considering the equal span of each frame as per Bangladesh National Building Code (BNBC)-2006. In this study, four different shaped (W-shape, L-shape, Rectangle, Square) ten storied RCC building frames are analysed using ETABS v9.7.1 and SAP 2000 v14.0.0 for seismic zone 3 (Sylhet) in Bangladesh. Comparative study on the maximum displacement of different shaped buildings due to static loading and dynamic response spectrum has been explored. After analysis it comes into account that, static load analysis, effects of earthquake force approximately same to all models except model-1(W-shape).W-shape has been found most vulnerable for earthquake load case. It is also found from the response spectrum analysis that the displacements for irregular shaped building frames are more than that of regular shaped building.

Diana M. Samoila, *et al* [5] They studied about infill walls in reinforced concrete structures has negative influence the structure behaviour to seismic loads. There might be a positive effect - an increase of the overall stiffness and strength, but a negative effect can also appear due to effort concentration in frame members. For modelling of masonry infill, there are of two types i.e., macro-modelling - equivalent strut method and the micro-modelling - finite element method. The study focuses on determining the width of compressed strut by means of different equations available in literature, but recommends the use of Paulay and Priestley relation. The effect of infill on frame structures is studied on various models, as the single-strut model, the three-strut model and finite element models.

Desai R.M, *et al* [6] In this study they studied that at present condition most of buildings structures are unsymmetrical in elevation based on the distribution of mass and stiffness along each storey throughout the height of the building. Most recent earthquakes have shown that the irregular distribution of mass, stiffness and strengths may cause serious damage in structural systems. Response spectrum analysis done over symmetric and asymmetric structures The buildings have un-symmetrical distribution of vertical irregular in storeys. The effect of eccentricity between centre of mass (CM) and centre of stiffness (CR) are kept into consideration. Three buildings (G+3), (G+6) & (G+9) models are considered for study, which are constructed on medium soil in seismic zone II of India (as per IS:1893-2002), one symmetric and asymmetric in vertical irregular distribution. Serviceability of a multi-storey framed building during ground motions depends on the distribution of mass, stiffness, and strength in both the horizontal and vertical planes of the building. In some cases, these weaknesses may be produced by discontinuities in stiffness, strength or mass between adjoining storeys. Such discontinuities between storeys are often allied with sudden variations in the frame geometry along the height.

Mohammad H. Jinya, *et al* [7] They studied about reinforced concrete frame building, brick masonry wall are used as infills and specified by architects as partitions in such a way that they do not contribute to the vertical gravity load-bearing capacity of the structure. Infill walls protect the inside of the buildings from the environment hazards and create separation insides. In addition to this, infills have significant effect on the seismic response of the structural systems. Mostly two common structural damages observed caused by masonry infill walls in earthquakes i.e soft stories and short columns. In this case central opening are provided in periphery wall with different percentage i.e. 15% and 25% and brick compressive strength are used as per IS : 1905-1987 i.e. 5.0 and 12.5 N/mm2 and Brick Masonry strength is 0.50 and 1.06N/mm2. In ETABS software G+9 R.C.C framed building models has been prepared, Seismic coefficient method(SCM) and time-history(TH) has been performed for analysis as per IS 1893:2002. Story displacement, base shear, story drift, axial force with and without soft story considering effect of infill walls with different percentage of opening are the parameters considered in this study. For Macro model, Equivalent diagonal strut (EDS) method is used to find out width of strut using FEMA approach method. The results of bare frame, soft story and infill walls nel are discussed and conclusions are made in this study.In this paper sixteen models are prepared for Static Linear analysis and Dynamic analysis (TH) results of models i.e. without strut and with strut of infill wall with central outer opening with 15% and 25% are compared.

Marina L. Moretti, *et al* [8] They studied about paper present the study for to calculate width of diagonal strut model for the design of reinforced concrete (RC) infilled frames, already broadly used as a design tool in the case of masonry infilled RC frames. The assumptions on which the strut model provisions in codes are based are reviewed. As well as, some of the results of an experimental study on the response of eight 1=3-scale RC infilled frames subjected to quasi-static cyclic horizontal displacements are summarized. Two different aspect ratios and different types of connection of the infill to the frame have been investigated. Design provisions for infilled frames included in codes are applied to describe the behaviour of the specimens tested in terms of stiffness, ultimate strength, and expected mode of failure. The results are discussed and some suggestions are made for improving the design procedures.

Mohammed yousuf, *et al* [9] They studied about main objective of earthquake engineering is to design and build a structure in such a way that the damage to the structure and its structural component during an earthquake is minimized. This paper presents the dynamic analysis of reinforced concrete structure with plan irregularity. Four models of G+5 building with one symmetric plan and remaining irregular plan have been taken for the investigation. The analysis of R.C.C. structure is carried out with the software ETABS 9.5. Estimation of response such as; lateral forces, base shear, storey drift, storey shear is carried out. Four cross sections in columns are considered for to study the effectiveness in resisting lateral forces. The paper also deals with the effect of the variation of the building plan on the structural response building. Dynamic analysis for various prominent earthquake, related to IS 1893–2002(part1) has been carried out. In dynamic analysis; Response Spectrum method is used.

Raghavendra Prasad *et al* [10] In this he studied about Reinforced concrete frames mostly incorporate with brick or concrete-block masonry walls. The presence of infill in reinforced concrete structures can decisively alter the behaviour of the structure under lateral loading. The increase in overall stiffness and strength is the positive effect of the presence of the infill. The analytical models for masonry infill are the macro modelling based on a physical understanding of the behaviour of each infill panel as a whole, represented by a single structural member termed as equivalent diagonal strut and the micro models, where each infill panel is represented with a fine mesh of finite elements.. The presence of infill is studied by several authors and developed various models to understand the behaviour and proposed diagonal strut model to incorporate the effect of Solid infill. Opening in the infill to accommodate the windows and doors for functional reasons are the inevitable part of infill. The presence of opening in the infill reduces the lateral stiffness of the infill frames. The one of the important objective of this paper is to investigate the reduction in initial lateral stiffness of the infilled frames with openings over that of solid infilled frames and propose a reduction factor for the diagonal strut for the infill with openings. The simpler ones are the equivalent diagonal strut models, which represent infills with a diagonal strut element. The important aspect of this paper is to provide a contribution for the simplified analysis and design procedure for the infilled frames, based on the numerical parametric study. The study of behaviour of infilled frames is carried out and based on the results a present a simplified formula to calculate the width of diagonal strut for infilled frames for different configuration of openings The present study is limited for single story, single bay to infilled frames with central opening. Future work can be carried to study the effect of position of opening and stiffened openings for multi story and multi bay infilled frames for various aspect ratio and relative stiffness.

Yuen, Kuang, *et al* [11] They Studied the structural and architectural point of view, masonry-infilled reinforced concrete frames are highly common structural forms for buildings. However, the infills can significantly modify the structural behaviour of these frames, which can be detrimental to the seismic performance of buildings. This analytical investigation presents the seismic response and failure mechanisms of infilled RC-frame structures with five different infill configurations: (1) full infills, (2) 2/3-storey-height infills, (3) a soft first storey, (4) infills with window openings and (5) infills with door openings. The nonlinear response of the masonry-infilled RC frames under four realistic earthquakes, namely, the 1979 El Centro, 1987 Superstition Hills, 1995 Kobe and 1999 Chi-Chi earthquakes, were simulated using discrete-finite element analysis with damage-based constitutive relations. It observed that the degrees of continuity and regularity of the infill panels significantly affect the seismic performance of structures. As long as out-of-plane collapse of infills does not occur, full-height and continuous-infill panels can enhance the overall stability and energy dissipation of frame structures. Discontinuous infills can cause serious damage localised at the points of discontinuity in the frame members. Furthermore, the analysis revealed that the design concept of ‘‘strong column–weak beam’’ may not be always applicable to infilled frames. The seismic behaviour of five typical types of infilled RC frame structures, namely, a fully infilled frame, an infilled frame with 2/3-storey-height infills, an infilled frame with a soft first storey, an infilled frame with window openings and an infilled frame with door openings under seismic excitations, were investigated in depth. The results of the analysis support the following conclusions.

G. Uva, *et al* [12] They studied participation of masonry infill panel to the overall seismic resistance of a framed building has a significant variation according to the specific mechanical characteristics of the infill, the geometrical distribution within the building and the local interaction among the panel and the surrounding primary RC elements. Especially in the case of structure designed only for vertical loads, essence of the infill can be decisive under an unexpected earthquake, providing an additional contribution to the strength and to the stiffness. On the other side, this beneficial role is often accompanied by the modification of the global collapse mechanisms, with the appearance of brittle failure modes. In the present paper, an existing RC framed building for which a good level of knowledge was available, including a wide experimental database, was chosen as a case study. A reference frame was considered for performing nonlinear static analyses aimed at investigating some significant aspects about the modelling of the infill and the relapse induced by the related computational choices on the structural response. In particular, it is faced the sensitivity analysis about specific parameters involved in the definition of the equivalent strut models: the width Bw of the strut; the constitutive Force–Displacement law of the panel; the number of struts adopted to simulate the panel.

Gaetano De Stefeno, *et al* [13] They Studied about that it is widely accepted that the interaction between masonry infill and structural members significantly affects the seismic response of reinforced concrete (RC) frames, such an interaction is generally neglected in current design-oriented seismic analyses of structures. The issue of modelling masonry infill is even more relevant in the case of seismic analysis of existing structures, as they can significantly modify both lateral strength and stiffness. As a matter of principle, accurate modelling of infill should be carried out by adopting nonlinear 2D elements. However, several design-oriented proposals are currently available in both scientific literature and engineering practice to model masonry infill by defining equivalent (nonlinear) strut elements. This paper demonstrates the OpenSEES capabilities in implementing the such models in nonlinear static and dynamic analyses. The present paper addressed the issue of modelling the seismic response of RC frames taking into account the possible influence of masonry infill by means of "practice-oriented" numerical models implemented in OpenSEES. The key aspects of the structural behaviour of both RC structural members and masonry were firstly summarised. Particularly, the simulation of the response of masonry walls was reduced to the definition of an equivalent strut whose monotonic behaviour can be described according to analytical expressions available in the scientific literature for defining the key features of the force-displacement skeleton curve; moreover, the cyclic behaviour of such equivalent struts has been simulated by taking into account both strength and stiffness degradation (in load and unload branches). The results obtained in the parametric analysis proposed herein confirm the importance of taking into account the role of masonry infill, as their influence cannot be otherwise quantified and simulated and can often result in unexpected effects, especially in the case of irregular distribution in elevation.

Himanshu Bansal, *et al* [14] They studied about the objective of the paper is to carry out Response spectrum analysis (RSA) and Time history Analysis (THA) of vertically irregular RC building frames and to carry out the ductility based design using IS 13920 corresponding to Equivalent static analysis and Time history analysis. Mostly there are three types of irregularities such as mass irregularity stiffness irregularity and vertical geometry irregularity were considered. According to our observation, the storey shear force was found to be maximum for the first storey and it decreases to minimum in the top storey in all cases. The mass irregular structures were observed to experience larger base shear than similar regular structures. The stiffness irregular structure experienced lesser base shear and has larger inter-storey drifts. The absolute displacements obtained from time history analysis of geometrical irregular structure at respective nodes were found to be greater than that in case of regular structure for upper stories but gradually as we moved to lower stories displacements in both structures tended to converge. Lower stiffness of strucure results in higher displacements of upper stories. In case of a mass irregular structure, time history analysis gives slightly higher displacement for upper stories than that in regular structures whereas as we move down lower stories results higher displacements as compared to that in regular structure. If a high rise structure (low natural frequency) is subjected to high frequency ground motion then it results in small displacements. Similarly, if a low rise structure (high natural frequency) is subjected to high frequency ground motion it results in larger displacements whereas small displacements occur when the high rise structure is subjected to low frequency ground motion.

Rajesh, *et al* [15] They Studied about the RC framed structures are greatly used in all over the world due to ease of construction and rapid progress of work, and generally these frames are filled by masonry infill panels, concrete blocks in many of the countries situated in seismic regions. Infill panels significantly increase stiffness and strength of frame, it behaves like compression strut between column and beam and compression forces are transferred from one node to another. Performance of building in earthquakes (like Bhuj Earthquake) clearly showes that the presence of infill walls has significant effect in structure stability. This study gives the overview of performance of RC frame buildings with and with-out infill walls. We compared the results for total weight of building, time period, base shear, and modal participation mass ratio and comparison of results. From the observation of the results it states that decrease in the time period will leads to increase in the base shear of the building and also total weight of the building is less in strut model as compared to bare-frame model buildings. Strut model buildings show the less time period and total weight of the building and higher in the base shear of the building. As if we know time period is inversely proportional to stiffness, here it is seen that strut model buildings has less time period than bare-frame buildings which can say that strut model buildings are more stiffer and safer during the earthquakes than the bare-frame models.

3. Conclusion

The study was carried on structure for carrying out the torsional effects on structure on regular and irregular shape out with considering the P-Delta effects on the high rise and low rise structures. Story drift is the important aspect of structural performance results. In this study going to compare structural models with each other without the contribution of infill, After assigning infill in the structures, there is much reduction in the drift value in the starting few stories from base. Study on various parameters time-history analysis, lateral displacement of structure story drift etc. As number of storey increases P-delta effect becomes more important. Generally, P-delta effects are negligible up to 10 storey buildings where only gravity loads are governing load combinations. But having significant effects in high-rise structure. Cross section of the member increase stiffness of the structure increase. P-Delta effect is negligible up to 7 storey building. The analysis carried by using computer programs like STAAD PRO, ETABS and SAP2000 structural analysis software's.

References

[1] Romanbabu M. Oinama, Ruban Sugumara, Dipti Ranjan Sahoob, "*A comparative study of seismic performance of RC frames with masonry infills",* 11th International Symposium on Plasticity and Impact Mechanics, Implast 2016. Procedia Engineering 173 (2017) 1784 – 1791

[2] Sanaa Elmalyh, Taoufik Elouali, Azzedine Bouyahiaoui**,** *"Review on Seismic Behavior of Infilled Frame Structures"* American Journal of Civil Engineering. Vol. 5, No. 2, 2017, pp. 75-89 .14 may 2017

[3] Syed Humayun Basha, Hemant B. Kaushik, *"Behavior and failure mechanisms of masonry-infilled RC frames(in low-rise buildings) subject tolateralloading"* Vol. 55 No. 2 oct 2012

[4] Mohaiminul Haque, Sourav Ray, *, Amit Chakraborty, Mohammad Elias1, Iftekharul Alam, *"Seismic Performance Analysis of RCC Multi-Storied Buildings with Plan Irregularity", American Journal of Civil Engineering*. Vol. 4, No. 3, 2016, pp. 68-73. 24 june 2012

[5] Diana M. Samoilă, *"Analytical Modelling of Masonry Infills*", Acta Technica Napocensis: Civil Engineering & Architecture Vol. 55 No. 2 -2012

[6] Desai R.M, Khurd V.G., Patil S.P., Bavane N.U., *"Behavior of Symmetric and Asymmetric Structure in High Seismic Zone",* International Journal of Engineering and Techniques - Volume 2 Issue 6, Nov – Dec 2016

[7] Mohammad H. Jinya, V. R. Patel, *"Analysis of RC frame with and*

[8] *without masonry infill wall with different stiffness with outer central opening"*, International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308

[9] Marina L. Moretti; Theocharis Papatheocharis2; and Philip C. Perdikaris, M.ASCE3, *"Design of Reinforced Concrete Infilled Frames",* American Society of Civil Engineers 10 sept 2014

[10] Mohammed yousuf, P.M. shimpale," *Dynamic Analysis of Reinforced Concrete Building with Plan Irregularities",* International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 9, September 2013

[11] K. H. Abdelkareem, F. K. Abdel Sayed, M. H. Ahmed, N. AL-Mekhlafy, "*Equivalent strut width for modeling r.c. infilled frames"* Journal of Engineering Sciences, Assiut University, Faculty of Engineering, Vol. 41, No. 3, May, 2013

[12] Raghavendra Prasad M.D 1 Syed Shakeeb ur Rahman 2 Chandradhara G. P. 3," *Equivalent Diagonal Strut for Infilled Frames with Openings using Finite Element Method",* IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 24-29

[13] Y.P. Yuen , J.S. Kuang, *"Nonlinear seismic responses and lateral force transfer mechanisms of RCframes with different infill configuration.pp 23-32, 20may 2014*

[14] G. Uva, D. Raffaele, F. Porco, A. Fiore, *"On the role of equivalent strut models in the seismic assessment of infilled RC buildings"* www.elsevier.comhttp://dx.doi.org/10.1016/j.engstruct. 2012.04.005

[15] Gaetano de stefano, carmine lima, enzo martinelli, "*on the seismic response of masonry infilled rc frames".*vol.12.4 feb 2015

[16] Himanshu Bansal, Gagandeep, *"Seismic Analysis and Design of Vertically Irregular RC Building Frames"* International Journal of Science and Research (IJSR) Volume 3 Issue 8, August 2014