International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

*Review Article*

# A Review on Buildings Having Highest Importance Factor Based on Live Load

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Received 10 Jan 2022, Accepted 07 March 2022, Available online 10 March 2022, **Vol.12, No.2 (March/April 2022)**

***Abstract***

*Every structure necessitates a table to live a system of battling highest forces caused by wind speed or heavy earthquakes. One of the premium preparations has to share the representation of structural elements that holds the arrangement of earthquake loads together. When the trouble of the tallness of the structure is superior than before they turn out to be greater as well as the addition of tempting additions to oppose systems such as truss contains of shear wall is essential. If the live load present in the structure has more, the reduction in the failure of the structural elements will be the main criteria before construction. In this work, some of the studies has presented in which they have introduced different live loadings in multi-storeyed building with seismic loading. Results concluded that it is necessary to perform the live load with highest importance factor as per seismic codal provisions.*

***Keywords:*** *Live load, Highest Importance Factor, Seismic loading, Multi-Storeyed Building.*

## 1. Introduction

One of the main difficulties in this era of construction biosphere is the tricky of empty and stable terrestrial. This lack in urban areas has showed to the vertical construction magnification of low-rise, medium-rise, tall buildings and even sky-scraper (over 50 meters tall). These buildings generally used Framed Structures subjected to the vertical as well as lateral loads. The seismic prone areas where the chances of earthquakes are comparatively higher the buildings collapsed which have not designed in concern to these seismic loads. All these above stated reactions make it major to study the source and effects of lateral loads and lead us how to erect this.

For buildings taller than 15 to 20 stories, pure rigid frame system is not adequate because it does not provide the required lateral stiffness and causes excessive deflection of the building. These requirements are satisfied by two ways. Firstly, by increasing the members size above the requirements of strength but this approach has its limitation and secondly, by changing the structural form into more stable and rigid to restrict deformation. This increases the structure's stability and rigidity and also restricts the deformation requirement.

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DOI: https://doi.org/10.14741/ijcet/v.12.2.1

### *Importance Factor*

The importance factor is a criterion used in the design of structures that comes under earthquake criteria. Importance factor needed to fulfill the requirements of live load present during seismic load. The stability needed to the structure under this also since we can control the side bending of structure, by providing shear wall. The shear wall will devour shear forces and prevents the location-position of construction from changing and consequently destruction. But one thing must be given importance that the shear wall arrangement must be supremely accurate, if not the resultant will give a negative effect instead. The shear wall comprises of braced panels (shear panels) to counter sideways load effects substitute on a building. Seismic loads and wind are amongst the maximum mutual loads that shear wall calculated to transmit. When she3ar wall is built, it is built in line form of severely braced and armor-plated sheets. This is why they are also known as braced wall lines in some region. The wall flawlessly attaches two exterior walls and braces other shear walls in the building. Bracing is achieved with heavy timbers and metal brackets or support beams that keep the wall steady and strong. The shear walls are now a vital part of mid- and high-rise buildings. A building to be a quake resilient design, these walls are positioned in the building plans which reduces lateral displacements under seismic loads. Thus, shear wall frame structures are attained.

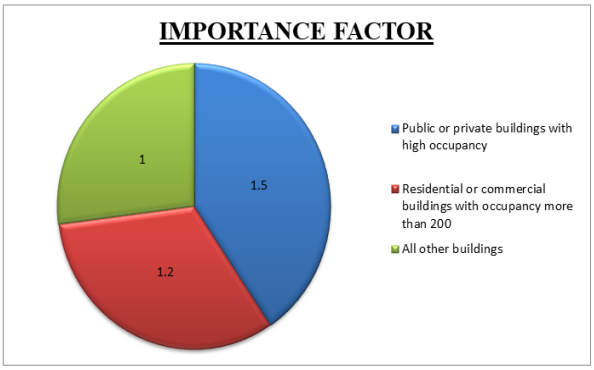


**Fig. 1:** Classification data on importance factor

## 2. Review of Literature

The world is growing faster and the need of the world is that the new ideas and technologies in construction area. The multi-storey buildings and skyscrapers are the today's world need. To make them safe, secure, durable and convenient it is very needed to add new ideas of construction in it. The reduction of base shear under seismic loading is the new method. In this method the column size of the building top floors are reduced which helps to reduce the base shear of the building under seismic loading. It also makes the building economic and reduces the dead load of the building.

***Ms. Priyanka Soni, Mr. Purushottam Lal Tamrakar, Vikky Kumhar (2016)***

This paper presents the behaviour of shear wall against lateral loads. Shear walls provide strength to the structure against lateral loads like wind and earthquake loads. This research work is based on the study and analysis of various research works based on shear wall system.[1]

***Anirudh Gottala, Kintali Sai Nanda Kishore, Dr. Shaik Yajdhani, (2015)***

The current study is based on the comparative study of static and dynamic seismic analysis of a multi-storeyed building. They have selected a G+9 multi-storeyed building made up of Reinforced Concrete frame building type. They have discussed that the frame have gone through several loading throughout their lifetime. Apart from dead load, they have also discussed live load separately other than the seismic loads. They have selected a linear seismic method of analysis conducted on virtual building by static method and dynamic methods by the help of STAAD-Pro. They used the old code as per their research time for seismic analysis and conclusion has drawn. They have concluded that the comparison is done between the static and dynamic analysis with various result output parameters, with the importance of importance factor of 1.2. At that particular time, the importance factor has only two values as per design code of practice. [2]

***Shen Yonglin, WU Lixin, LI Zhifeng, LI Xiaojing, (2010)***

In the country of china at the year 2010, the severe earthquake caused a major economic problem and a huge loss of life. The earthquake named was "Yushu earthquake". For the study of the same, the researchers in year 2016 published a paper that emphases on the technique related to three dimensional visualization to scale the disaster map that focuses on pre and post conditions of the earthquake with disaster management. They have used images from remote sensing data of high resolution. After analysing the data for various purposes, they concluded the purpose of study. The building characteristics obtained from remote sensing images were presented with different information by extraction of data. Conclusion seems that after the usage of three dimensional technique, the live load presented on the building requires different colour images with picturing the seismic building loads in confusive earthquake.[3]

***Z.T.Değer, U. Gökçeoğlu, (2021),***

The issues in tall buildings has described in this research. The project started with 26 storied virtual building that has to be designed including a tower along with a podium consists of a basement wall located in Istanbul, Turkey. For analysis, loads such as dead load, live load etc. taken into account with architectural necessities that require the nonappearance of basement walls. For the determination of seismic height of the building, turkish seismic building code has taken into consideration and the design methodology was based on the same. CSI ETABS was used to construct the building structure with the basement wall input parameters. The cost of construction was totally based on the design outcomes like sizes and reinforcing ratios of the different structural elements. With the reinforced concrete shear walls placed in both directions, the key decisions will provide a case study for the upcoming researches to design the tall buildings. [4]

***Shahzad Jamil Sardar and Umesh. N. Karadi, (2013)***

The researcher mainly focuses on the implementation of shear wall by using the analysis software E Tabs. They have created a structure and applied load such as wind, EQ, live and dead load as per the floor level configurations. To provide the stiffness they suggest implementing the shear walls that is required to bear the major loads. They have created 25 storied building under seismic zone V and obtained a simple seismic analysis. They have not used live load reduction criteria as per method of analysis; since the codal provisions suggests that we have to assign the input parameters first to create the seismic waves to the structures. These seismic waves then applied to the structural members throughout. The live load reduction criteria will provide feasibility when live load applied to it. The result parameters like storey drift, storey shear and

displacement then used to determine the actual output to the building. [5]

***S. R. Uma, (2006)***

The researcher in this research paper needs to elaborate the behavior of structure at seismic effects and behavior of beam column joints at that situation. Researcher said the poor performance of the node at which the beam and column links since the stiffness depends on the reinforcing criteria. Also, the way of designing and implementation of codal recommendation were gone through complex mechanism of the jointsNZS 3101: Part 1:1995, ACI 318M-02 and the Euro-code 8 of EN 1998-1:200 were taken into account. Joints shear requirements and bonding requirements will be satisfied by these three design codes. Compared the design influencing factors by all three codal recommendations with processing parameters like anchorage conditions, shear stress level, depth of column, stirrup reinforcement and axial load capacity of column were pointed out. The detailing of reinforcement by all three codes was suggested in the research gap. [6]

***Mohammed Qamaruddin, Abdul Wahid Hag, Salim Al-Oraimi, Saleh Hamoud, Al-Hashmi and Salem Juma Al-Waheibi, (1997)***

The researchers have proposed the new method by evaluating the three methods of design by in-plane stiffness by using the shear walls in a structure. Openings in this were the main criteria of cost reduction and efficiency. The result parameters were selected to determine the comparison between three methods and new suggested methods. The finite element approach is better than that of the suggested three methods. The dead load and live load imposed on the elements will be transferred to the walls is not significant but the application of the loads provide the in-plane stiffness to the junctions of its connections. The live load and the live load importance factor was not discussed properly and should be provided to determine the exact situation of the authors point of view since the seismic behaviour of the structure has pointed out and needs to follow the same. [7]

***Mohammad Ashrafy, Reza Aghayari, Mehrzad Tahamouli Roudsari, (2018)***

The research gap first found out by the researchers before came to the conclusions of the effects on the height of the structure and the base shear geometry of RC coupling beam systems. The seismic method was conducted in this approach and the authors first recommend the pushover analyses on the reinforced coupling beams on many stories. Opening ratio and area of wall section parameter have played a very important part in the analysis of the structural elements connected to the coupled shear walls. The difference in in the wall plane and out of the plane shear wall criteria were shown in the analysis part. The out of the plane type models shows the smaller base shear than in the wall shear wall system. Opening are effects also effects the coupling beam RC wall systems connections because in coupled wall, the natural time period and the base shear can also assist the structural behavior. [8]

***Christian Geiß, Hannes Taubenböck, Sergey Tyagunov, Anita Tisch, Joachim Post, Tobia Lakes (2014)***

The correlation between physical information indirectly by the help of seismic data of buildings and remote sensing data has shown in their study. They have selected urban area of the city of Padang, Indonesia for their research. They have predicted the seismic exposure to the levels of buildings by arranging the data into sequential way to identify significant sets by the help of machine learning. They have received the observation by applying the vector regression approach with 10.6 percent of absolute percentage error. They have received the observation and recommended when the load applied on the building, the data has to be collected first over the larger area and the characteristics of the building elements can be determined before construction of the new buildings in the seismic prone area. [9]

***Bahador Bagheri, Ehsan Salimi Firoozabad, and Mohammadreza Yahyaei, (2012)***

In their study, various multi-storeyed buildings have created in irregular plan configuration and selected G+ 20 storied configurations. They have used the ETabs analysis software and SAP2000 software for analysis results and have selected the earthquake zone V as per Indian Standards. Actual earthquake prediction analysis over the selected building cases by selecting the EL-CENTRO 1949. They have also investigated on CHI-CHI Taiwan 1999 earthquake by selecting the data and put it into the analysis software. They have analysed all the cases and recommend the exactness and perfectness of time history analysis method of analysis over equivalent static analysis and response spectrum analysis. Variation of building height over the response of earthquake over the selected building cases has presented in their study by the application of shear wall in it for stiffness purpose. [10]

***Jagmohan Humar, Praveen Kumar, (2000)***

The authors have suggested that during an earthquake, the unsymmetrical building has gone through many loads and deliver uneven shaking effects due to torsional oscillations. Before design, the analysis procedures that resists the forces prompted by torsional vibrations has suggested by various seismic codes as observed by them. New buildings have created with new design provisions and design proposals. They have selected the single Storey building model and

observed the inelastic and elastic response studies. They have finally concluded that many design codes have not emphasized the torsional effects to a structure with a low value of torsional stiffness and suggested the new provisions to be implemented in the various design codes for improvement. [11]

***J.K. Whittle, M.S. Williams, T.L. Karavasilis, A. Blakeborough, (2012)***

The researchers have used the time history analysis in the seismic performance of the structure. By using the three advanced and two standard viscous damper placement techniques, they have selected total five different result evaluation observations. The main objective of their research was the reduction of different output parameters such as residual drifts, interstorey drifts and absolute accelerations to suggest the comparison on different cases. The seismic hazards levels were selected at two steel moment resisting frames for the evaluation of the placement techniques. The result assessment of time efficiency and usability of each damper have then pointed out in their study. They have recommended the best method of damper placement out of 5 different methods. [12]

***Kassem, M.M.; Beddu, S. Ooi, J.H. Tan, C.G.; Mohamad El-Maissi, A., Mohamed Nazri, F., (2021)***

To estimate the seismic vulnerability of buildings in a particular selected area, the researchers often used the rapid visual screening technique that has simple and rapid method as discussed by the researchers. They have selected an area of Northern and Eastern George Town, Malaysia with over 500 building data has selected. The utilization of modified FEMA-154 (2002) code of practice that was suited in their research was described by the authors of the research paper. Google map data, Google earth data, online sources data have selected and suggested that traditional surveying data collection through street screening has the old method of data collection techniques. By observing the topology, the seismic assessment based on the RVS performance score has conducted and conclusion have drawn in their study that damage state 2 and state 3 have observed in 220 building by selecting 500 buildings in their selected area. [13]

***Lang Liu, Qingyang Ren, and Xu Wang, (2020)***

As per AASHTO LRFR specifications, the live load analysis over Highway Bridge has presented in their research and presented the load ratings for structural reliability. As the researchers have selected the few reliable truck data's, they have recommended the calibration method with the live loading factors. As per the AASHTO rating specifications, they have recommended the elimination of the unnecessary over reaction in ratings. For this, they have collected the large amount of data mainly named as WIM data in California region of ten year duration. They have calibrated the live load factor as per ratings to fix their objectives of their study. For the bridges study of span length less than 300 ft, 1.0 and 0.7 live load factors along with load configurations are recommended in their study and observations have presented. [14]

***Dr. B. Kameshwari, Dr. G. Elangovan, P. Sivabala, G.Vaisakh, (2011)***

The dynamic response of high rise structures under the influence of discrete staggered shear walls was the title of their research and in their study, analytical study have conducted. The dynamic analyses have conducted and analysis results of different shear stiffened wall configurations. The dynamic result parameters like inter story and story drift have obtained and also various conclusions have observed. For lessoning the effects of dynamic response of a structure, high storied shear walls would be effective. Shear walls placed along the shorter plan dimension gives better results than that in longer plan dimension in controlling the dynamic response. Storey drift reduction would be about 83% and simultaneously story drift has reduced by 84% when compared to bare frame type of building. They have used old seismic codal provisions which have the importance factor values of 1.5 and 1 respectively.[15]

***B. Doran, (2003)***

As per the researcher, the most popular method in structural design in coupled shear wall systems was the bare frame method. The important part in the process was the determination of the stiffness of tie beams. The analysis results obtained from the finite element analysis of reinforced coupled shear wall systems are considered. The geometry part considered made up of elastic-plastic space. An equivalent tie beam stiffness modification parameter was provided by usage of SPSS (Ver.5.0) statistical package program for analysis purpose. They have considered the formula that expresses the relation between the plastic and elastic equivalency with stiffness modification parameters is also assumed. [16]

***Mirza Aamir Baig, Tanveer Sultan Bhat, (2020)***

As per the research gap of the study, the authors suggested that most of the research advancements have conducted in the field of the Tuned mass dampers and all the series of seismic base isolators. They have suggested the positive and negative points base on evolving, analysing and design parameters to conduct seismic loading and wind loading. For the determination of output parameters, a general structure consist of 50 stories have selected. They have obtained the results by comprehend the different structural cases, compared each other and concluded that the time history analysis and analysis result by pushover analysis technique can be used to design the structures.

The live loading in their regard was taking different as per the stories taken [17]

***R. Sulzer, P. Nourian, M. Palmieri, J.C. van Gemert, (2018)***

As per the research, the authors found out the different criteria of seismic analysis and design of structures based on shape. They have used different techniques such as Remote sensing, inspection data and cadastral data. From this, they have developed a technique for automatic prediction of the type of structural building type by GEM model. This has possible only by a model which has its own learning approach as described by the authors. With the accuracy of above 80%, the roof type data structure has predicted by synthetically generated building database. The structural elements they have found was the lateral load resisting systems with the above 75% accuracies only by taking construction year and building area of footprint. Load such as live load and various factors have also taken into consideration. [18]

## Conclusions

Based on the diverse researchers learning on Performance point determination criteria of multi-storied building by varying opening area percentages in shear wall used in periphery with earthquake zone III the subsequent conclusions are to be prepared. The points out conclusions are as given below:

1) The main of researcher in the above paper is to increase the performance of tall structures under seismic loading.
2) Under the behavior of the various earthquake zone, the performance of shear wall is measured.
3) The key purpose of the investigators is to growths of structure and Stability of the structure used; hence increase is observed by diverse investigators.
4) The extreme investigation is grounded on the perfect tallness, shear wall locations, differences in shear wall location etc. but not included he highest importance factor criteria.

*The need of the study will be required in this topic and analysis of the structure under the highest importance factor criteria should be included to bifurcate the type of the structure as per Indian Standards.*

## Future Scope

The following future worked as carried out to get the knowledge of live loading present in the building and to invention deeper perception and new considerable knowledge through it. They are as follows:

1) Less difficulty will be there since of compact size of column and provision of highest importance factor.
2) It is determined that structure is created in lesser price as compared to building deprived of using the highest importance factor.
3) Increase the performance of tall structure by using various soil conditions using the highest importance factor.

## Acknowledgement

I extend my deepest gratitude to my guide Mr. Arvind Vishwakarma, Assistant Professor, Department of Civil Engineering, Oriental University, Indore, (M.P.) for providing all the necessary facilities and feel thankful for their innovative ideas, which led to successful completion of this review work.

## References

[1]. Albert Philip and Dr. S. Elavenil (2017), Seismic Analysis of High Rise Buildings with Plan Irregularity. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 1365–1375.
[2]. Ms. Priyanka Soni, Mr. Purushottam Lal Tamrakar, Vikky Kumhar, (2016), "Structural Analysis of Multistory Building of Different shear Walls Location and Heights", International Journal of Engineering Trends and Technology (IJETT) – Vol. 32, No. 1.
[3]. Anirudh Gottala, Kintali Sai Nanda Kishore, Dr. Shaik Yajdhani, (2015), "Comparative Study of Static and Dynamic Seismic Analysis of a Multistoried Building", IJSTE - International Journal of Science Technology & Engineering, ISSN (online): 2349-784X, Vol. 2, Issue 1.
[4]. SHEN Yonglin, WU Lixin, LI Zhifeng, LI Xiaojing, (2010), "3D Visualization of Seismic Buildings in Yushu Earthquake for Disaster Management", The International Conference on Multimedia Technology, ISBN: 978-1-4244-7872-9.
[5]. Z.T.Değer, U. Gökçeoğlu, (2021), "Effect Of Basement Wall Configuration On Tall Building Design Based On 2018 Turkish Seismic Building Code", 6th ICEES, Turkey.
[6]. Shahzad Jamil Sardar and Umesh. N. Karadi, (2013), "Effect Of Change In Shear Wall Location On Storey Drift Of Multistorey Building Subjected To Lateral Loads", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 2, Issue 9.
[7]. S. R. Uma, (2006), "Seismic design of beam-column joints in RC moment resisting frames – Review of codes" Structural Engineering and Mechanics, Vol. 23, Issue 5.
[8]. Mohammed Qamaruddin, Abdul Wahid Hag, Salim Al-Oraimi, Saleh Hamoud, Al-Hashmi and Salem Juma Al-Waheibi, (1997), "Investigation On The Lateral Stiffness Of Shear Walls With Openings"11th International Brick Block Masonry Conference Tongji University, Shanghai, China.
[9]. Mohammad Ashrafy, Reza Aghayari, Mehrzad Tahamouli Roudsari, (2018), "The Effect of Structural Height and Geometry on the Base Shear of RC Coupling Beam Systems", Research Report , Razi University , Kermashah , IRAN.
[10]. Christian Geiß, Hannes Taubenböck, Sergey Tyagunov, Anita Tisch, Joachim Post, Tobia Lakes (2014), "Assessment of Seismic Building Vulnerability from Space", Earthquake spectra, Vol. 30, Issue 04.
[11]. Bahador Bagheri, Ehsan Salimi Firoozabad, and Mohammadreza Yahyaei, (2012), "Comparative Study of the Static and Dynamic Analysis of Multi-Storey Irregular Building", World Academy of Science,

Engineering and Technology International Journal of Civil and Environmental Engineering Vol. 6, Issue 11.

[12]. Jagmohan Humar, Praveen Kumar, (2000), "A New Look At The Torsion Design Provisions In Seismic Building Codes", 12th World conference on EE, Number 1707.

[13]. J.K. Whittle, M.S. Williams, T.L. Karavasilis, A. Blakeborough, (2012), "A Comparison of Viscous Damper Placement Methods for Improving Seismic Building Design", Journal of Earthquake Engineering, DOI: 10.1080/13632469.2011.653864.

[14]. Kassem, M.M.; Beddu, S. Ooi, J.H. Tan, C.G.; Mohamad El-Maissi, A., Mohamed Nazri, F., (2021), "Assessment of Seismic Building Vulnerability Using Rapid Visual Screening Method through Web-Based Application for Malaysia", Buildings, Vol. 11, Issue 485.

[15]. Lang Liu, Qingyang Ren, and Xu Wang, (2020), "Calibration of the Live Load Factor for Highway Bridges with Different Requirements of Loading", Advances in Civil Engineering, Hindawi, Vol. 2020, Article ID 7347593.

[16]. Dr. B. Kameshwari, Dr. G. Elangovan, P. Sivabala, G.Vaisakh, (2011), "Dynamic Response Of High Rise Structures Under The Influence Of Discrete Staggered Shear Walls", International Journal of Engineering Science and Technology (IJEST), Vol. 3, Issue 10.

[17]. B. Doran, (2003), "Elastic-plastic analysis of R/C coupled shear walls: The equivalent stiffness ratio of the tie elements", J. Indian Inst. Sci., paper no. 83.

[18]. Mirza Aamir Baig, Tanveer Sultan Bhat, (2020), "Seismic Upgradation of Tall Buildings", International Journal of Engineering Science Technologies, ISSN: 2456-8651, Vol.4, Issue 5.

[19]. R. Sulzer, P. Nourian, M. Palmieri, J.C. van Gemert, (2018), "Shape Based Classification of Seismic Building Structural Types", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 13th 3D GeoInfo Conference, Volume 42, Issue 4.