IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Review Paper on Analysis of Tall Building by Using Approximate Method of Analysis

Mr. Ujwal Bhongade[1], Dr. Abhijeet Wadekar[2], Dr. Rahul Pandit[3]

1. Student of Master of Engineering (Structure), P.E.S. COE, Aurangabad (MH)
2. Department of Civil Engineering, Principal P.E.S. COE, Aurangabad (MH)
3. Department of Civil Engineering, Assistant Professor P.E.S. COE, Aurangabad (MH)

ABSTRACT: The study of this paper is based on an approximate analysis for multistory building structures which is stiffened by an arbitrary combination of lateral load-resisting subsystems (shear walls and frames). The studied analysis is based on the approximate methods (i.e., Vertical Load method, Portal Frame method, Cantilever Method, Substitute Frame Method). After the study, it concluded that an approximate method is useful in preliminary design, and also provides the analyst and the designer with a rapid means of rough checking “exact” solutions and these kinds of analyses of building frames for vertical loads are covered in several papers. This paper intends to review an approximate analysis of building frames for vertical loads.

Keywords: Vertical load method, Portal Frame Method, Cantilever Method, Spilt Frame Method, KBS, Story wise Summation.

1. INTRODUCTION:

Approximate methods are useful in preliminary design and also provide the analyst and the designer with a rapid means of rough checking "exact" solutions. The approximate analysis of building frames for vertical loads is covered in several papers. The current trend towards taller buildings and lighter forms of construction has brought to light several difficulties in the design of tall structures. Architectural and other requirements lead to a form of construction with a spine or core and with perimeter columns, or structural mullions, and a floor slab spanning between. In contrast to vertical loading, lateral load effects on a building increase exponentially with an increase in its height. During the last four decades, engineers have developed several new framing schemes for tall buildings to minimize the material used. In general, frame tube structures are widely accepted as an economical system in high-rise buildings over a wide range of building heights.

2. LITERATURE REVIEW:

2.1 Introduction:

A current literature review includes the approximate analysis of structure by portal method, vertical load method, and also software-based analysis of tall building systems.

Jinghai Wu (1)

This study presented a simplified storey wise summation method. The existing stories summation method is complicated in calculations. The simplified story-wise summation method is summarized as follows: (1) Divide a building frame into many single-story frames whose number equals the number of stories of the building frames; (2) Approximate analyze each single-story frame; & (3) sum the single-story frames. The method is almost as accurate as the existing story-wise summation method.

Some basic assumptions are taken into account for simplified story-wise summation method are as follows; (1) The side sway of building frames for vertical load is neglected; (2) The far end of each column is assumed to be fixed; (3) Load acting on the beam of the same story have little influence on beams of other stories. The simplified story-wise summation method is almost as accurate as the existing story-wise summation method and may provide better accuracy than the other approximate methods. The simplified story-wise summation method may involve less labor in computation than the existing story-wise summation method and is proposed for the approximate analysis of building frames for vertical loads.

Mathi Ravi & Claude Bedard (2)

This paper demonstrates the use of the KBS system. A knowledge base system for the design of multi-story buildings is presented. The system initially generates overall building configurations followed by structural configuration selecting and placing the vertical structure in appropriate locations. The structure is then designed using approximate methods of analysis and simplified sizing procedures. Such approximate methods are effective in a KBS environment to generate structural alternatives that have a reasonably good degree of detail.

The modeling of structural systems for approximate analysis is an important step. KBS techniques capture the expertise in the process of selection of appropriate methods as well as the modeling to perform the analysis. The approximate analysis and design are essential steps in the preliminary building design process. The combination of heuristic and procedural methods of computing as adopted permits the use of such established methods of structural analysis KBS environment.

J. C. D. Hoenderkamp and H. H. Snijder (3)

A simplified method of deflection analysis for high-rise frames with flexible beam-column connections is presented. The method allows a rapid assessment of a structure's adequacy in sway resistance due to horizontal loading in addition to a quick comparison between the influences of different types of connections on the lateral deflections. It is also possible to combine flexible frames with other types of bents such as rigid frames, braced frames, and shear walls are symmetric as well as asymmetric structural floor plans.

The theory is based on the assumption of, and therefore is most accurate for, structures that are uniform throughout their height. It may be used also, however, for practical structures whose properties vary with height, but with less accurate results. The information obtained from this method should give the design engineer an easy means of comparing the suitability of alternative structural proposals, in addition to providing initial structural data for a more accurate analysis or allowing a check on the reasonableness of the final output of computer analysis.

Semih S. Tezcan (4)

The shear distribution example of a 19-story building demonstrates that the results of the approximate hand calculations procedure may produce considerably erroneous results. The high percentage of the error is mainly because the irregular variations of the stiffness are through the height of the building are not taken into account in the hand calculations.

More accurate shear distribution results are expected from the complete stiffness analysis if the capacity of the available computer is sufficient for such an analysis. The reduced stiffness matrix approach based on the rigid floor system assumption may be used if the capacity is small. It is possible to calculate the working stresses both in the concrete and in the steel simultaneously. In other words, it is possible to achieve the direct design of the shear walls if a stiffness analysis is applied to a complete structure of the concrete plate and reinforcing bars.

Hans J.C.D. Hoenderkamp (5)

A general hand method for deflection analysis is presented for structures with non-symmetrically arranged stability systems. The lateral load resisting elements may include combinations of shear walls, rigid frames, braced frames, coupled walls, and wall frames (punched walls). The method allows an assessment of a structure's adequacy in sway resistance due to horizontal loading for different structural proposals. The theory is based on the assumption of, and therefore is accurate only for, structures that are uniform through their height. It may be used, however, to obtain the approximate deflection and comparison of sway between practical structures whose properties vary with height.

Nobin Samuel Philip1, M.G. Rajendran (6)

The results obtained by the split frame method for short frames and the split frame method for tall frames are in harmony with the solution of the improved portal method and cantilever method respectively. This method does not involve much computational effort. For tall buildings, it is better to deal with shear force as done in the split frame method than axial forces in the cantilever method which is prone to mistakes. Variable beam shear method and stationary beam shear method can be used as a supplement method to overcome the disadvantage of the simplified portal method.

R. A. Behr (7)

Inappropriate assumptions in the approximate analysis of vertically loaded rectangular frames can lead to significant errors. Assuming inflection points at both ends of each girder and zero axial force in all girders leads to erroneous results in simple examples. Improved assumptions are required to obtain realistic approximate solutions for vertically loaded rectangular frames.

W. M. Jenkins and T. Harrison (8)

The stiffness matrix approach, with a digital computer, is seen to provide a suitable method for the analysis of tall structures containing shear walls. The method is quite general and can be applied to different types of shear wall structures providing the stiffness's can be calculated. Floor slab stiffness's can be included using the finite element technique. A fine division of floor slabs will lead to a large number of additional unknowns in the overall stiffness matrix but this can be reduced by condensation before the assembly of the matrix. The 2 x 2 division adopted for the floor slabs of model 2, stage 2 is seen to be too coarse. The floor slab stiffness is overestimated and consequently, the calculated displacements are too low (Fig. 16). However, the stress distributions in the walls at the first-floor level are reasonably well predicted. The torsion analysis using the theorem of minimum potential energy is convenient and simple to use. It requires the summation of several series and these have been produced for any number of stories up to thirty. The method requires the setting up and solution of a small number of simultaneous equations.

T.C. Liauw (9)

An approximate method, using the concept of equivalent frame, is presented for the analysis of infilled frames with or without wall opening in the infill. The analytical results obtained by the method were compared with the results obtained from the elastic model experiment using shows good agreement between the analytical and experimental results when the opening is more than 50% of the infill area, and the method is on the conservation side when the opening is less than 50% of the full initial area.

The potential of the method is that it can be extended to deal with multi-story multi-bays infilled openings and organically, and also infilled plane frame with openings, and also infilled space frames.

Reza Rahgozar, Ali Reza Ahmadi, Yasser Sharifi (10)

In this paper, a primary non-continuous structure with a set of simple assumptions is modeled as a continuous structure with orthotropic plates. In the proposed method, the distribution of axial deflections in each panel of flange or web is considered independently. Closed-form solutions are obtained, from which the effects of various parameters on the overall structural behavior can be readily evaluated. So, the shear lag in each panel of flange and web of the frame are calculated separately. It is revealed that for 45 and 55 storied buildings when the belt truss is located at H/6 height from the base, the proposed approximate method overestimates the maximum axial stress by 7.5% and 7% and underestimates the maximum lateral displacement by 1.2% and 1.5% respectively.

Azzam Katkhoda, Rana Knaa (11)

This paper presents the economic cost of reinforced concrete high-rise buildings consisting of 10-15-20 storied by studying three structural systems with price change and determining the best structural system that achieves saving in the use of concrete and steel materials for two types of soil profile SA and SB. The couple structural system (C) achieved the best results in both soil profiles SA and SB, hence the optimization in the design of the reinforced concrete high-rise buildings.

K. A. Zalka (12)

It has been demonstrated that the application of the equivalent column concept to a single moment resistant framework under uniformly distributed horizontal load can be further extended to the analysis of a system of frameworks, (coupled) shear walls, and cores. Based on a 'base unit' (the unit with the most shear-dominated deflection), a closed formula is presented for the deflection analysis of symmetric multi-story buildings. It is possible to separate the deflection into three distinctive parts: the bending deformation of the building, the shear deformation, and the interaction between the bending and shear modes. The effect of interaction is always beneficial. Its contribution (in reducing the deflection of the building) depends on the 'slenderness' of the building; as a rule, the higher (slenderer) the structure, the less significant the interaction becomes. The derivation of the formulae for the deflection also demonstrates that the method of simply adding up the corresponding stiffness's of the bracing units to create an equivalent structure (as widely circulated in the literature) is theoretically not correct and, as the results of a comprehensive accuracy analysis show, leads to gross (and unconservative!) errors.

Somsak Swaddiwudhipong & Sitthichai Piriyakoontorn (13)

The analysis of asymmetric frame-core wall tall buildings subjected to lateral loads is carried out using the Bubnov-Galerkin method. The effect of axial deformation in frames is considered in the formulation of the governing equations. Three sets of displacement functions of an admissible class are discussed. Numerical studies are carried out to demonstrate the accuracy and simplicity of the proposed method which may be easily implemented on any personal computer.

Jack P. Moehle (14)

Nonlinear dynamic analysis is increasingly being used as a tool to verify the seismic performance of significant structures. Available software tools, research results, and experience gained through real building applications are providing a basis for the effective application of nonlinear analysis procedures. Important considerations include the definition of performance objectives, selection of input ground motions, construction of an appropriate nonlinear analysis model, and judicious interpretation of the results. Implemented properly, nonlinear dynamic analysis specific to the structural system and seismic environment is the best way to identify nonlinear dynamic response characteristics, including yielding mechanisms, associated internal forces, deformation demands, and detailing requirements.

Yifei Xiao, Huaying Li (15)

In this study variety of methods are currently available to analyze buildings in an earthquake, some of them are only used for low-rise buildings and some of them cannot provide accurate results due to the ignorance of the higher modes effects. In this research program, GFM which considers the higher mode effects is proposed to analyze the performance and seismic response behavior of tall buildings. By performing this task, four different multi-story buildings with varying heights ranging from 100m to 200m are analyzed. In addition, to verify the accuracy of GFM, computer simulation is conducted by applying the ETABS software package. The results show that whether the torsion effect is considered or not, the displacement and inter-story drift are reliable and accurate enough when applying GFM.

Shilpa Nirman Thilakarathna & Naveed Anwar (16)

This study compares the seismic performance of a 40-story high-rise RC building designed based on different levels of lateral wind loads. It is shown that the true nonlinear seismic demands obtained from the detailed NLRHA procedure at the MCE-level seismic hazard are higher than those of both the wind and seismic demand determined by the RSA procedure. This shows that the level of design wind load can alter the seismic performance of high-rise dual system buildings. Therefore, even for the cases where the wind demands control the design of a lateral load resisting system, a detailed performance-based seismic evaluation should be carried out to ensure the overall structural safety and integrity.

K. Nagarathna, Dr. B. Ramesh Babu (17)

This study shows shear walls are one of the most effective building elements in resisting lateral forces during earthquakes. By constructing shear walls damages due to the effect of lateral forces due to earthquakes and high winds can be minimized. Shear walls construction will provide larger stiffness to the buildings thereby reducing the damage to the structure and its contents. Not only has its strength, to accommodate the huge population in a small area tall structured with shear walls are considered to be most useful. Hence for a developing nation like India shear wall construction is considered to be a backbone for the construction industry.

Q.S. Li (18)

In this study the analytical models of the flexural-shear plate were prepared for buckling analysis from that they find a very sensitive point in failure of buckling of a shear wall they discuss this problem and governing differential equation is established. Using appropriate transformations, the equation is to reduce to an analytically solvable equation by selecting a suitable expression.

Romy Mohan (19)

From the above studies, it can be concluded that Equivalent Static Method can be used effectively for symmetric buildings up to 25 m in height. For higher and unsymmetrical buildings Response Spectrum Method should be used. For important structures, Time History Analysis should be performed as it predicts the structural response more accurately in comparison with the other two methods since it incorporates p - Δ effects and material nonlinearity which is true in real structures.

S. Natarajan, S. Veeraragavan (20)

In this literature review study, all research and from that concluded some various points about the shear wall. E.g., if a shear wall is provided then the story displacement was reduced by 50%, the thickness of the shear wall in between 150mm to 400 mm irregular buildings should be analyzed for torsion, shear walls are more resistant to lateral load and also can reduce the torsion effect.

Rakshit Patil, Avinash S Deshpande (21)

In this study create the models with shear walls with different locations (e.g., at the core of the building, at the corner of the building). From this study, they analyze if a shear wall is provided at the core of the building Is more effective to reduce the displacement than the shear wall provided in corner of the building. Reduction of storey drifts due to introduction of a shear wall at the core sections of the building, which enables the structure to behave as almost ideally stiff. In this way, the damage risk of the structure & non-structural elements is minimized.

Mayur N. Prajapati, Prof. Vishal V. Patel (22)

This study compares the different types of structural systems with various parametric study and their response comparison for the structural system. This study found that reducing the seismic effect by changing the structural system of building into something more rigid and stable structure to confine the deformation and increase the stability of the structure.

Mehani Youcef, Kibboua Abderrahmane (23)

The analysis of absolute displacements of a building using linear response spectrum methods, taking into account indirectly the nonlinear behavior of structural elements by introducing the behavior factor, and the nonlinear static analysis using pushover procedure have been performed.

Piotr Adam Bonkowski, Zbigniew Zembaty, Maciej Yan Minch (24)

In this study, initial leaning resulted in the bending moment in the structure reducing the compression in some of the walls or even leading to tension in some of them. The reduced compression in the walls facilitated their cracking and decreased their bending stiffness. Depending on the value of initial leaning and excitation intensity the wall: is not going to crack at all, responds with stiffness reduced by cracking during all time-history response, or presents transient response (partly with initial stiffness, partly cracked).

Pan Fenga, Wu Xingkuan (25)

In this study, the author studies the changing and development is eternal, but the question is how to act? The thinking of sustainable development has provided us with a whole new concept, which with more value of culture, economy, and ecology. Just as one comment said in "The Architectural Review", "Change is the driving force to culture and society, everything will be gone, but it is not mean something upheaval or destructive". We should be kind to the earth and environment, regarding the sustainable development of high-rise buildings as an opportunity rather than a constraint for our feature.

Dipak M. Kolekar, Mukund M. Pawar (26)

In this study the researcher gate tables and graphs it can be concluded that one has to accept that as we increase the number of the story the base shear, story shear, and base moment get increased. Also, for the same storey if we increase the zone from zone II to zone V there is an increase in base shear, story shear, and base moment and it is maximum in zone V.

Q.S. Li (27)

In this paper, an analytical model of a flexural-shear plate is proposed to buckle analysis. It is discussed that it is possible to model a narrow building with shear walls as a flexural-shear plate for buckling analysis. This problem has not previously been investigated in the past and thus, the solution of this problem has not been proposed yet in the literature. The governing differential equation of such a plate is established. Using appropriate transformations, the equation is reduced to an analytically solvable equation by selecting suitable expressions, such as power functions and exponential functions, for the distribution of stiffness along with the height of the plate.

Ali Ruzi O zuygur(28)

The building has an extremely irregular structural floor plan imposed by rigid architectural requirements which are not usually suitable for tall building structures. Despite the irregularities and coupling effects induced by sky floors, all the design phases including linear elastic as well as nonlinear time history analyses have successfully been completed. The approach of R = 2 usually underestimates the shear demand of walls about nonlinear time history analyses by MCE, and accordingly, more amount of shear reinforcement is needed based on the result of nonlinear time history analyses.

Behnoud Ganjavi, Iman Hajirasouliha (29)

In this study, a practical optimization technique is developed to obtain optimum lateral load distribution for seismic design of non-linear shear buildings by considering soil structure in tractions (SSI) effects. It is shown that the optimum design lateral load pattern of flexible-base structures with SSI is highly dependent on the fundamental period, target ductility demand, non-dimensional frequency, aspect ratio, seismic excitation, and structural damping model.

N. R. Chandak (30)

IS code depicting the higher values of base shear for similar ground types defined in the other codes which may lead to overestimating the overturning moment and could result in heavier structural members in the building. For the buildings, IS code gives the maximum and UBC gives the minimum displacement values. In the case of torsional response, IS code gives maximum, and UBC, EC8 gives minimum values. In most cases, the estimated drifts for structural components subjected to earthquake force satisfied the drift demand (as per IS Code) for immediate occupancy level, indicating that the structural responses are mainly elastic.

Seung Yong Jeong, Thomas H.-K. Kang (31)

Coupling beams in tall buildings are the most vulnerable under seismic loads and require appropriate hysteretic modeling. To describe the pinching effect, the pivot hysteresis model with previously proposed values is recommended for conventionally reinforced coupling beams. The confinement effect of the underground structure transfers torsional modes for the T-shaped plan to higher modes. These torsional modes are easily amplified by high-frequency components of ground motions that can translate into local damage of coupling beams at the upper part and basement of the building. The seismic performance evaluation using RE with strong high-frequency components can be an alternative for an enhanced evaluation of local damage.

Roberta Apostolska, Golubka Necevska-Cvetanovska (32)

Intensive migration of people and concentration of material resources in urban megalopolises impose new modern concepts of construction of residential and administrative structures. In most cases, such buildings are designed and constructed by use of modern materials and integrated structural systems which are not usual for typical buildings.

Finley A. Charney (33)

Without a standard methodology for the wind drift serviceability limit state design of multistory buildings, different engineers will design buildings with varying levels of performance, and with an inconsistent economy. After the completion of the

the research proposed herein, such a standard may be developed.

Dipak J Varia, Dr. Harshvadan S Patel (34)

Matrix inversion, Equation solving and Iterations are eliminated and the evolved method gives speedy and nearly accurate joint moments. The novel approximate method can always be adopted for a rapid check. The method evolved is novel for the analysis of High-rise frames, which gives near accurate results. The approximate method is very useful to design engineers because a substitute frame can quickly analyze with almost 90 to 95 % accuracy in comparison to exact analysis.

Md. Anisur Rahman Muhammad Masum, Syeda Zehan Farzana (35)

All buildings will be designed and constructed to sustain within the allowable drift limitations specified in the code. The study presents a practical procedure for the calculation of the drift value of different types of buildings. From this study, it was found that the most sustainable approach of reduction of drift is to provide shear walls because shear wall provides significant resistance to lateral deflection of buildings.

Bahman Omar Taha (36)

The moment coefficient of different continuous multi spans are determined and compared with the ACI-coefficient method of elastic analysis. Two, three, four, and five multi spans continuous beams are analyzed for two cases, the external supports are simply supported and fixed. Different groups of combinations are considered taking span ratios between (0.5 and 2.0). When the external supports are fixed, the bending moment (WL2/12) is suggested at both sides of the support. For the continuous portal frame, the end moments at the column decreased with increasing the column height, which is a benefit to reduce the load eccentricity, i.e. increasing the load capacity (internal strength) of the column. For a single span portal frame, the end and mid-span moments of the beam vary between the results of the full fixed ends condition and simply supported end condition depending on the ratio of the beam to column stiffness ratio. A negative moment appears at some mid-span and a positive moment appears at supports in some span arrangement combinations, which is opposite to that obtained by the ACI- simplified method of analysis for non-prestressed continuous beams and one-way slabs.

Life John, Dr. M G Rajendran (37)

The various approximate methods of structural analysis for the analysis of framed structures subjected to vertical and horizontal loads have been described above. The comparison of moments in the column has been done. The average variation is 20.92 %. In beam, the analysis can provide a reasonably accurate value in most cases. The average error % is 10.38 %. From the above results, it can be concluded that further refinement is necessary and an analytical study is being carried out in the above field.

R. A. Behr, E. J. Grotton, C. A. Dwinal (38)

A reliable, reasonably accurate approximate method of structural analysis for symmetric, rectangular frames under symmetric vertical loadings has been developed. Using the revised assumption sets for either fully loaded or checkerboard-loaded cases, solutions were superior to those from the slightly different set of assumptions found in many contemporary structural analysis textbooks.

2.2 Concluding Remark:

The literature review shows that,

1. The work done so far has given us a clear idea about the approximate analysis method for lateral load and also for vertical load analysis.
2. The approximate analysis is mostly done on symmetric structures.

References

1. Approximate analysis of building frames for vertical loads (Jinghai Wu 1995)
2. Approximate methods of structural analysis and design in a knowledge-based system environment (Mathi Ravi & Claude Bedard 1993)
3. Approximate analysis of high-rise frames with flexible connections (J. C. D. Hoenderkamp, And H. H. Snijder 2000)
4. Analysis and design of shear wall structures (Semih S. Tezcan)
5. Approximate deflection analysis of non-symmetric high-rise structures (Hans J.C.D. Hoenderkamp 1995)
6. Approximate lateral load analysis of tall buildings- a comparative study (Nobin Samuel Philip, M.G. Rajendran 2015)
7. Potential errors in approximate methods of structural analysis (R. A. Behr 1989)
8. Analysis of tall buildings with shear walls under bending and torsion (W. M. Jenkins And T. Harrison)
9. An approximate method of analysis for infilled frames with or without opening (T.C. Liauw 1972)
10. A simple mathematical model for approximate analysis of tall buildings (Reza Rahgozar, Ali Reza Ahmadi, Yasser Sharifi 2010)
11. Optimization in the selection of structural systems for the design of reinforced concrete high-rise buildings in resisting seismic forces (Azzam Katkhoda, Rana Knaa 2012)
12. A simple method for the deflection analysis of tall wall-frame building structures under horizontal load (A.K.Zalka 2009)
13. Analysis of tall buildings considering the effect of axial deformation by the galerkin method (Somsak Swaddiwudhipong & Sitthichai Piriyakoontorn 1989)
14. Seismic analysis, design, and review for tall buildings (Jack P. Moehle 2006)
15. Simplified method for analysis of tall buildings in an earthquake (Yifei Xiao, Huaying Li 2019)
16. The effect of wind loads on the seismic performance of tall buildings (Shilpa Nirman Thilakarathna, Naveed Anwar 2018)
17. Analysis and design of multistoried building with shear wall (K. Nagarathna, Dr. B. Ramesh Babu 2016)
18. Stability of tall buildings with shear-wall structures (Q.S. Li 2000)
19. Dynamic analysis of rcc buildings with shear wall (Romy Mohan 2011)
20. A review on analysis and design of shear walls in high rise irregular building(S. Natarajan, S. Veeraragavan 2016)
21. Optimal location of shear wall in high rise building subjected to seismic loading (Rakshit Patil, Avinash S Deshpande 2016)
22. Parameters comparison for different structural system (Mayur N. Prajapati, Prof. Vishal V. Patel 2016)
23. Seismic performance of rc building using spectrum response and pushover analyses (Mehani Youcef, Kibboua Abderrahmane 2018)
24. Seismic effects on leaning slender structures and tall buildings (Piotr Adam Bońkowskia, Zbigniew Zembaty, Maciej Yan Minch 2019)
25. Sustainable development of high-rise building (Pan Fenga, Wu Xingkuan 2011)
26. Study of base shear, storey shear and base moment on multistory building for different seismic zones (Dipak M. Kolekar, Mukund M. Pawar 2017)
27. Stability of tall buildings with shear-wall structures (Q.S. Li 2001)
28. Performance-based seismic design of an irregular tall building – a case study (Ali Ruzi O Zuygur 2015)
29. Optimum lateral load distribution for seismic design o fnonlinear shear-buildings considering soil-structure interaction (Behnoud Ganjavi, Iman Hajirasouliha 2016)
30. Response spectrum analysis of reinforced concrete buildings (N. R. Chandak 2012)
31. Seismic performance evaluation of a tall building: practical modeling of surrounding basement structures (Seung Yong Jeong , Thomas H.-K. Kang 2020)
32. Seismic performance of rc high-rise buildings – a case study of 44 storey structure in skopje (macedonia) (Roberta Apostolska, Golubka Necevska-Cvetanovska 2016)
33. Wind drift serviceability (Finley A. Charney 1990)
34. A novel approximate method for analysis of high-rise building frames (Dipak J Varia, Dr. Harshvadan S Patel 2015)
35. A study on drift analysis for lateral stability of high rise building in sylhet city corporation area (Md. Anisur Rahman Muhammad Masum, Syeda Zehan Farzana 2014)
36. Comments on the approximate elastic analysis of continuous non prestressed reinforced concrete beams and portal frames (Bahman Omar Taha 2018)
37. Comparative studies on exact and approximate methods of structural analysis (Life John, Dr. M G Rajendran 2013)
38. Revised method of approximate structural analysis (R. A. Behr, E. J. Grotton, C. A. Dwinal 1990)