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Performance Evaluation of Shear wall Positioning & Bracing System in RCC Building

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Abstract

Although the behavior of high rise structures are studied and better solutions are made available for architects and designers to select appropriate structural systems for high rise buildings, yet it still remains as a challenge. While selecting a suitable structural system for a particular building one should make an attempt to measure its behavior in many ways like economy, strength, aesthetics etc. Hence there is + to study of behavior of various structural systems in building. The present paper deals with the study of behavior of G+10 RCC Residential irregular building in seismic zone V; to investigate the behavior of Shear wall System braced with bracings. Keywords: Structural systems, Shear wall, Diagonal Bracing, Cross Bracing, Chevron bracing, Irregular building.

Tall structures also experience horizontal displacement or deflection under earthquake loads. To prevent this lateral displacement of the structure from becoming excessive, the structure must be reasonably stiff to resist the lateral forces. The bracing system is a system of members and connections that resists lateral deflection of a structure. Members of braced frames are subjected to tension and compression. Therefore, their design is similar to that of a gantry and there are many methods for their design based on various mechanisms.

Keywords: Tall Buildings, X, Bracing, zone , Response Spectrum Method, software, shear wall.

1. Introduction

The rapid advancement in tall building construction has led to a significant increase in multi-storey structures over recent decades, primarily driven by the demand for vertical expansion in residential and commercial spaces within major urban centers. The design and engineering of tall buildings require the adoption of suitable structural systems depending on the height range, as no single system is efficient for all building heights. Selecting the appropriate system, along with understanding its effective application range and the implications of extending its limits, is essential for achieving an economical and safe design.

For a building to perform effectively, In addition, the structure should have adequate ductility, stiffness, and lateral load-resisting capacity to ensure safety and minimize damage under external forces. In reinforced concrete (RCC) framed structures, it becomes necessary to evaluate systems that can effectively resist seismic and wind loads.

For medium to high-rise RCC buildings, designers often consider systems such as RCC shear wall frames and steel braced frames as viable alternatives. Previous studies have extensively examined the impact of steel bracing and shear walls on the seismic behavior of both regular and irregular structures. These systems play a crucial role in enhancing structural performance under earthquake loading conditions.

In this context, the present study focuses on evaluating the effectiveness of different structural systems. The structure is modeled with shear walls strengthened using bracing, where two shear walls are continuously braced along the full height of the buildings.

2. Literature Survey:

Based on the available literature, the seismic performance of RC buildings can be significantly improved by effectively incorporating shear walls and bracing systems. The results obtained from studies have shown that the optimal placement of shear walls has a profound effect on limiting the structural displacement and story drift, and by doing so, they significantly enhance the structural stability. In addition, the previous studies demonstrated that a hybrid system consisting of shear walls and bracing systems can achieve better results than single systems in terms of increasing the stiffness and reducing the structural displacement. Recently, some studies introduced the application of advanced methods, including machine learning techniques and reliability-based analysis, for improved structural behavior prediction and optimal design. Moreover, incorporating innovative materials, such as recycled aggregate concrete, can enhance the sustainability and performance of RC structures. A well-planned combination of conventional and innovative shear walls, bracing systems, and modern analysis techniques lead to seismic resistant structures with superior performance.

1) **Parash Kunwar Khand , Prakash Poudel , Amit Poudel (2025)**

Title – Enhancing seismic performances of RC building :A reliability – based approach to shear wall positioning.

Explanation – The study shows that , how to improve seismic performance of RC buildings using a reliability-based method. It also considered like material properties and earthquake loads in their analysis. The used of advanced methods instead of traditional fixed values. Different shear wall positions were tested in the building models. It was found that central walls improve serviceability, while corner walls help in strength. The method gives more realistic and accurate results. So, reliability-based design is useful for better structural performance.

Conclusion – The overall final study show that , considering uncertainties gives better and more practical design results. Proper placement of shear walls increases safety and stability of building. Reliability-based approach is more advanced than traditional methods. So, it is useful for designing earthquake resistant structures.

2) **Srivastav and Singh (2025)**

Title: Dynamic Analysis of Bracing System in Multi-Storey Building

Explanation: The study shows that , how bracing system affects the dynamic behavior of multi-storey buildings. The study is done on G+8 building and it is analyzed on STAAD-PRO software . The study shows comparison between building with bracing and without bracing under earthquake load. The final result shown from study is that bracing reduces storey displacement and drift and it also increases stiffness of structure , the time period of building becomes less when bracing is used. Therefore building becomes more stable during earthquake .

Conclusion – The final conclusion says that , using bracing system is very useful in multi-storey buildings. It helps to control displacement and improves strength of structure.

Bracing makes building safer against earthquake forces.

3) **Patel and Sinha (2025)**

Title: Retrofitting of Existing Building using Steel Bracing System

Explanation: The study shows that , retrofitting of an existing RC building using steel bracing system. The analysed of soft-storey building which is weak during earthquakes is done. The comparison between steel bracing , RC jacketing and shear wall method is studied. From that analysis the results shown in study is steel bracing increases stiffness and strength of structure.It also reduces storey drift and displacement during seismic loading.The building becomes more stable after retrofitting. Therefore steel bracing is an effective method for improving old buildings.

Conclusion – The overall final conclusion is that retrofitting is very important for old buildings and steel bracing is simple & economical method. It also improves strength and controls damage during earthquake , therefore the final result from study shows that it is seismic safety of existing structures.

4) **Khand et al (2025)**

Title: Reliability-Based Shear Wall Positioning.

Explanation – The study shows that , placing shear wall in building by using reliability method. It also considers uncertainty in loads and material properties. The different position of shear wall were analysed in the building , therefore it shows that proper positioning reduces displacement and storey drift , with that it also increases the stiffness.

Conculsion – The overall final conclusion says that , the position of shear wall affects building performances and by using reliability approach it gives more accurate and safe design with that it also helps to reduce risk of failure during earthquake , so it is important to understand proper shear wall placement is necessary so that building can remain stable .

5) **Ambusaidi & Hassan (2025)**

Title: Influence of Wall Placement

Explanation – The study shows that , the shear wall placement in multi-storey buildings, by showing different positions like center , side and corner , which are analysed. The building tested under earthquake loading by using software. Therefore wall placement affect displacement and drift of building. The corner position gives minimum displacement and better stiffness. The time period also shows that it reduces when proper location is selected , therefore final result from study shows that , correct placement of shear wall improves seismic performances.

Conclusion – The final conclusion from study shows that , position of shear wall is very important , & corner placement gives better strength and stability.it also helps to reduce damage cause due to earthquake, therefore proper wall location should be considered in design.

6) **Yibin Liu , Wanlin Cao , Zhaoyuan Yang , Jinliang Bian (2024)**

Title – seismic performance of recycled-aggregate-concrete-based shear walls with concealed bracing .

Explanation – The study shows that , shear walls made using recycled aggregate concrete along with concealed bracing. It shows the performed tests under cyclic loading to check seismic behavior. It was found that even though recycled concrete slightly reduces strength, the final performance is still acceptable. When concealed bracing is provided, the strength and stiffness increase. It also improves ductility and energy dissipation capacity of the structure. The results show that this system behaves almost similar to normal concrete walls. So, it is a good option for both performance and sustainability.

Conclusion – The overall conclusion from study shows that , that using recycled aggregate concrete with concealed bracing gives good seismic performance. It improves ductility and energy absorption of structure. It also supports sustainable construction by using waste materials. So, this method is useful for future eco-friendly buildings.

7) **Domadzra & Hasan (2024)**

Title: Effective Position of Shear Walls

Explanation – The study shows that ,effective positioning of shear walls in high rise building . The study is done on total 9 models of G+15 storey with height of 3m each ,& the models are analyzed using a dynamic response spectrum analysis in the seismic zone, following the IS 1893-2016. The structural analysis software ETABS is used to referee all the models.

Conclusion – The overall final conclusion is , that placing shear walls at the center of building gives best performance during earthquakes. It increases stiffness and reduces displacement. Improper location may reduce efficiency. So, correct positioning of shear walls is very important for safe design of structures.

8) **Rai & Yadav (2024)**

Title: Optimal Shear Wall Placement

Explanation – The study shows that , shear wall behaviour in multi storey buildings highlighting their effects on structural response to lateral loads for different seismic zone and building configurations. Shear wall serve as strong upright diaphragm in construction of building used for carrying lateral stresses from the exterior-wall, floor and roof to foundation. Parallel to their planes these walls are primarily designed to with stand wind and earthquake loads. The analysed is done on multi-storey building by using design software.

Conclusion – The final conclusion is , that optimal placement of shear walls improves seismic performance of buildings. It reduces displacement and increases overall stability. Proper location depends on structure type and loading. So, careful planning of shear wall position is necessary for safe design.

9) **Lufeng Wang, Jiepeng Liu (2023)**

Title - Constructing a Personalized AI Assistant for Shear Wall Layout Using Stable Diffusion

Explanation – The study says that , Shear wall structures are widely used in high-rise residential buildings, and the layout of shear walls requires many years of design experience and many trial and error. Some methods are also used in this study like n heuristic algorithms, but they generate results too slowly. Those based on Generative Adversarial Networks (GANs) or Graph Neural Networks (GNNs) can only generate single arrangements and require large amounts of training data.The analysed are done by using AI and some algorithms .

Conclusion – The overall final conclusion by using AI is , The experiments conducted in this study have demonstrated that the proposed method can effectively assist designers in their work. Additionally, the procedures and open-source software provided in this paper to train and improve their own AI models.

10) **Mohebi, Sartipi and Kazemi (2023)**

Title: Performance of Buckling Restrained Bracing System under Seismic Load

Explanation: The study says that , to improve the performance of conventional bracing systems, in which, buckling in the pressure loads is the main disadvantage, the buckling-restrained brace (BRB) is introduced as a solution. It explains that BRB helps in reducing buckling problem which occurs in normal bracing.it introduced improved systems like double-stage yield bracing and use of special materials. Different building models were analyzed under earthquake loading. The final answer show that BRB systems improve energy dissipation and reduce damage in structures. It also helps in controlling displacement and increasing stability. So, BRB is very useful for seismic resistant design.

Conclusion – The final conclusion is the study shows that three proposed innovative lateral resisting systems that can be replaced for the BRB system. The proposed systems have been verifed and implemented in 2- to 12-story elevation BRBFs to evaluate their efects on the structures. To better present the efciency of proposed lateral-resisting systems, two types of analysis including NDAs and IDAs were performed considering DBE and MCE levels for far-feld ground motions.

11) **Wang et al.(2023)**

Title: AI-Based Optimization

Explanation – The study shows that , how AI can be used for optimization of shear wall design. It used a deep learning method called GAN to generate better wall layouts. It learns from previous design data and creates new optimized designs. The method helps in improving structural performance and reducing material usage. It also saves time compared to traditional manual design. The results show that AI-generated layouts are more efficient. So, AI-based optimization is useful in modern structural engineering.

Conclusion – The final conclusion from study shows that , AI can help in optimizing shear wall design easily. It reduces time and gives better performance results. The use of deep learning improves accuracy and efficiency. So, AI-based optimization can be very helpful for future structural design work.

12) **Yamini Rai, Mrityunjay Kumar Yadav (2022)**

Title – A study on optimal shear wall placement in reinforced concrete structure

Explanation – The study says that , different positions of shear walls in RCC buildings were analyzed. Shear walls were placed at locations like corners, edges, and core of the building. The models were studied to see how the structure behaves under seismic loads. It was observed that the position of shear wall affects displacement and drift. Proper placement helps in reducing these effects. The study shows that shear walls improve overall performance of the building.

Conclusion – The final conclusion from study is , location of shear wall is very important for seismic safety. Buildings perform better when shear walls are placed properly. It helps in reducing displacement and increasing stiffness. So, correct positioning of shear walls should be considered in design.

13) **Shashank Srivastav, Daljeet Pal Singh (2022)**

Title - Dynamic analysis of RC building with comparison between Shear Wall and Bracing System using STAAD PRO Software.

Explanation – The study says that , the buildings suffer seismic stresses during an earthquake that may cause lateral and torsional deflections, therefore influencing structural stability as well as occupant comfort. Minimising these impacts and improving general safety in multi-story structures depend on enough lateral stiffness being ensured. Structural performance of reinforced concrete (RC) frame structures is enhanced using many lateral load-resisting techniques. Among them, shear walls and cross bracings are most often used since they withstand seismic stresses very well. The study is done on G+8 residential RC structure with shear wall placed at many points and cross bracing. The analysed of model is done under STAAD-PRO software.

Conclusion – The conclusion says that , Shear wall and bracing are good structural solutions for reduction of lateral displacement and story drift. 2. Shear wall seems to be more effective than the braces for control

of deflection 3. The maximum displacement was found on brace and values in case of brace and shear wall are 27.978 mm and 16.553 mm in Zone III in Response spectrum Method for G+8

14) **Asgar and Singh (2022)**

Title: Effect of X Bracing and Diagonal Bracing on Structural Stability

Explanation: The study is done on tall building which are subjected to earthquake under the action of lateral load , which provides a suitable lateral forces resisting the significant performance of RC structure . The study is done on G+13 storied RC frame structure and it is considered under behaviour of seismic zone ((III, IV and V) , The IScode 1893:2016(part 1) is refered and analysed of model is done under STAAD-PRO software.

Conclusion – The conclusion from this study is , All the bracing frame models have been analyzed by response spectrum analysis and static analysis using software STADD PRO for all selected parameters namely, storey displacement, storey drift, Base shear, a maximum weight of the structure and maximum axial force. From the analysis of bracing models, it has been observed that the braced frame modeled structure has shown better seismic resistance than an unbraced structure in all seismic zone i.e. III, IV and V.

15) **Shrestha et al. (2022)**

Title: Impact of Wall Location.

Explanation – The study is done on how the position of shear walls affects the behavior of RC buildings during earthquakes. Different models were analyzed by placing shear walls at different locations. It was observed that buildings with shear walls show less displacement compared to normal buildings. The stiffness of the structure also increases when shear walls are used. Among all cases, symmetrical or central placement of walls gives better performance. If walls are placed at improper locations, torsion effect may increase. So, location of shear wall is very important in design.

Conclusion – The final conclusion is , that shear wall location plays an important role in seismic performance. Proper placement reduces displacement and improves stability of building. Symmetrical positioning is more effective. So, while designing building, correct wall location should be considered for safety.

16) **Chuleshwar Prasad, K Divya (2021)**

Title - Analysis of RCC Framed Structure with Shear Wall with and without Bracing System.

Explanation – The study says that , the performance of RCC buildings using shear walls and bracing systems under seismic loads. Different models were created with only shear walls and with a combination of shear walls and steel bracing. The analysis was carried out using ETABS software. The results showed that adding bracing along with shear walls significantly reduces storey displacement and drift. It also increases the stiffness and stability of the structure. The combined system performs better compared to

using only shear walls. Hence, using both shear walls and bracing is an effective method for improving seismic performance of buildings.

17) **Radhika Rajeev, R. Senthil Kumar (2021)**

Title- Analysis of RCC Building with and Without Shear Wall - An Overview**.**

Explanation – The study says that , there is increase in the used of earthquake resistant structure , so it is necessary to design and analyse the structure for seismic effect. The study shows an over-view and research done on RCC structure. It also study the performances of shear wall locating on different position in building. The shape and plan position of the shear wall influences the behavior of the structure considerably **.**

Conclusion - The conclusion from study is , development on the seismic performances of multi- storied building with shear wall & without shear wall .The study also shows that the maximum deflection of multi- storied building with shear wall is less compare to without shear wall or framed structure.

18) **Khaled Mahdi Al-Qudaih, Prathibha Reddy T(2021)**

Title - Seismic and Wind Analysis of Multistorey Building with Shear Wall.

Explanation – The study shows that , The analysis of RCC buildings under seismic and wind loads. Different models were analyzed with and without shear walls. From the results, it was observed that buildings with shear walls show better performance. Shear walls help in reducing displacement and storey drift. They also increase the stiffness and stability of the structure. The study concludes that shear walls are very effective in resisting lateral forces. Hence, they are important for safe structural design in earthquake and wind-prone areas.

Conclusion – The conclusion of study is , that shear walls play an important role in improving the performance of RCC buildings under seismic and wind loads. They help in reducing displacement and storey drift. The stiffness and stability of the building also increase when shear walls are provided. Buildings with shear walls perform better than those without them. So, shear walls are very important for resisting lateral forces.

19) **Zad & Melhem (2021)**

Title: Parametric Study on Wall Location.

Explanation – The study shows that , to minimize the earthquake- induced damage in structure , the reliable way for it is to construct earth-quake resistant building is to used reinforced concrete shear wall because they increase the structural resistance to lateral loads and effectively stiffens and strengthens the structure. This is known as the best seismic-resistant design method that ensures the stability of multi-story buildings against lateral forces when subjected to strong earthquakes. The study is done on 5 storey RC building by the SAP2000 is used to perform dynamic analysis under the 1994 Northridge earthquake, an example of severe seismic excitation.

Conclusion – The conclusion shows that , This study analyzed a structure with and without shear walls to determine the effects of shear walls and shear wall locations on a building's response to a severe earthquake event (the 1994 Northridge earthquake was selected). Nonlinear modal time history analysis is also called Fast Nonlinear Analysis (FNA), which is more meticulous and effective than direct integration time history analysis.

20) **Sai Kumar et al. (2021)**

Title: Effect of Shear Wall Location

Explanation – The study shows that , : Multi-storey buildings tend to get damaged mainly during earthquake. Seismic analysis is a tool for the estimation of structural response in the process of designing earthquake resistant structures and/or retrofitting vulnerable existing structures. It's main purpose is to analyze and design a building with a shear wall and also to find the appropriate position of shear wall that result in maximum resistance towards lateral forces and minimum displacement of the structure & study is done on G+7 multi-storey building and the model is analysed on ETABS.

Conclusion – The conclusion of the study is , The displacement is decreased in shear wall structure as compared to framed structure. There is nearly 50% reduction in displacement of structure is obtained when the shear wall is placed at locations & in both Earthquake loading and Response spectrum loading cases.

21) **Berkay Topaloglu , Gulsen Taskin Kaya , Fatih Sutcu (2021)**

Title - Machine Learning-Based Assessment of Energy Behavior of RC Shear Walls

Explanation – The study says that , it is explained that current seismic design mainly focuses on strength and displacement but does not consider energy dissipation properly. The energy-based approach is important because it considers repeated earthquake loads. The study focuses on RC shear walls and their energy dissipation capacity. A machine learning model (GPR) was used to predict the energy behavior of shear walls. Data from many tested shear walls was used for analysis. It was found that some design parameters greatly affect energy dissipation. the study shows that understanding energy behavior can help in better seismic design.

Conclusion – It's final conclusion is , large database of shear wall specimens was used to study energy dissipation behavior. Different types of shear walls and their design parameters were considered. The energy dissipation was calculated and normalized for better comparison. Machine learning was used to find the important factors affecting performance. the study shows that data-based methods can help in better understanding and design of shear walls.

22) **Aparna Nishtala, Ajay Radke (2020)**

Title -Review of Using Shear Walls & Bracings for Seismic Strengthening of HighRise RC Structures.

Explanation – The study says that exploring seismic resistance of high rise building through the implementation of shear wall and steel bracing system. The use of reinforced concrete (RC) buildings with shear wall systems and steel structures with concentrated steel bracing systems has become increasingly

common to understand seismic effect. The study also says that , responses of these system on seismic load varies due to differences in structure design when earthquake occurs.

Conclusion – The conclusion from is , Shear wall placement is very important, and floor bracing orientation is less important than for vertically oriented systems, although adjustments can improve seismic resistance. location is a key factor in seismic response.

23) **Patel & Prajapati (2019)**

Title: Seismic Analysis Study

Explanation – The study says that , shear wall are most common used to resist lateral forces like seismic load, wind load etc. shear wall has high strength that provides stability to structure , but with that providing shear walls are expensive so , therefore study also says that by adding some extra beams at different places in dead wall to create more stable and economical structure and it should be carried out by considering different seismic zones.

Conclusion – The conclusion from study says that , shear wall gives better stiffness and strength to structure . Location of shear wall gives best result when provided at the center of periphery of building. As for more stability additional bracings are added which also increase the cost of the structure. These all parameter indirectly increase the dead weight. To reduce such dead weight of structure additional beams can be incorporate at particular location of which can balance lateral forces coming from earthquake and also reduce dead load.

24) **Deepna et al. (2018)**

Title: Comparative Study

Explanation – The study says , that 10 storey commercial steel building designed to analysed under lateral loading , The bracing used in this to analysed are crossed bracing, V-type bracing, and eccentric bracing, in this comparison between story displacement , story drift , moment on beam between braced and un-braced structure at different floor level . The main point from this study is that when crossed braced structure lateral displacement is reduced by 41% , which is largest one & it significantly gives greater structural stiffiness.

Conculsion – The conculsion from study says that , all calculation are done by considering the cases and finally it is said that , Among all models, braced structure has shown better resistance than unbraced structure. Finally, it has been found that among all the structures considered, X-Braced structure is the best option among all from the structural point of view

25) **M. A. Ashraf (2015)**

Title: Comparative Study of X Bracing and V Bracing System

Explanation: The study says comparison between X and V bracing , the study is done because vulnerability of seismic force on high rise structure leads to sudden collapse which is unpredictable and study is also done on provision of indian standard . The study is done on 5 storey RC building model and then combination of gravity and seismic forces are analysed . overall each bracing performance is analysed and the focus is done on 3&4 zone by using IS code . Keywords: Bracing Systems, Equivalent Lateral Force Method, Response Modification Factor.

Conculsion – The conculsion of study says, t 1. Concrete 'X' bracing of cross section 150 X 200 was showing better performance in zone-3 as it has the highest percentage decrement in drift. 2. ISA150 'X' bracing steel was showing better performance in zone-4 as it has the highest percentage decrement in drif. 3. When steel bracings are used, it is seen that, there is almost the same percentage decrement in drift in both the earthquake zones. For the proposed structure, choosing of a particular type of bracing system also plays a vital role in the performance of a building subjected to lateral loads.

26) **B. G. Birajdar (2014)**

Title: Analysis of Different Types of Bracing Systems in Buildings

Explanation: The study shows that seismic analysis of high rise RC building frame have been carried out by considering different type of bracing systems . bracing system is very efficient and unyielding lateral resisting system . The study is done on G+10 story building frame is analysed for different bracing under seismic loading . for this STADD-PRO software is used and all types bracings are compared (X Bracing, V Bracing, K Bracing, Inverted V Bracing, and Inverted K Bracing) this bracing are compared in model and which bracing is more economical is seen in study.

Conclusion - The study some conclusion take outed through there research are

The concept of using steel bracing is advantageous to resist the seismic forces.

2. The bracing system effectively reduces the lateral displacement (up to 80%) of the structure compared to Bare frame.

3. Steel bracings the amount of forces in members significantly reduces.

4. Bracing system proves as a effective member to control the story drift (up to 56%) in structures as compare to Bare frames.

5. After using bracing member as a resistive member margin of safety against collapse increased.

27) **Mishra, Sharma and Garg (2014)**

Title: Seismic Performance Evaluation of Braced Structures

Explanation: The study says that , Bracing systems is very efficient and unyielding lateral load resisting system and the analysis is done in high rise building of RC building frame where different types of bracing are considered also with that study says the bracing is one of component in RC building for increasing stiffness and strength to help building to remain stable . The study is done for G+10 building model by using different type of bracing under seismic loading , The analysis of building is done under STAAD-PRO software.

Conclusion- The conclusion of the study is concept of using steel bracing is advantageous and has future scope to resist seismic forces . The bracing system effectively reduces the lateral displacement (up to 80%) of the structure compared to Bare frame. Steel bracings the amount of forces in members significantly reduces. Bracing system proves as a effective member to control the story drift (up to 56%) in structures as compare to Bare frames.

28) **H. S. Choi (2012)**

Title: Effect of Steel Bracing on Seismic Performance of Structures

Explanation: The study shows that , structural performances of steel building with different bracing system is shown and it also says that effectiveness of various type of bracing system on structure is analyzed .In this references , the study is done on storied commercial steel building and it is analysed under lateral loading . the study shows check is done by using different types of bracing . main point to noted from this references is , it has been found that in case of crossed braced structure lateral displacement is reduced by 41% which is the largest one and thus significantly contributes to greater structural stiffness. The study says said that cross diagonally braced structure shows better structural performance among all the structures considered here under similar circumstances.

Conclusion : overall all analysed of commercial building is done by using V- type bracing , which shows that in some cases x direction unbraced structure shows maximum value and maximum reduction in displacement value . the study shows calculation done on v-type bracing where maximum is found and where reduction in or how much value is found for displacement

29) **R. S. Jangid (2010)**

Title: Seismic Behaviour of Braced Building Structures

Explanation: Structures in high seismic risk areas may be susceptible to severe damage in a major earthquake. For the variety of structures and possible deficiencies that arise, several retrofitting techniques can be considered. Bracing system is one of the retrofitting techniques and it provides an excellent approach for strengthening and stiffening existing building for lateral forces. Also, another potential advantage of this system is the comparatively small increase in mass associated with the retrofitting scheme since this is a great problem for several retrofitting techniques.

Conculsion : In this dissertation work, an analytical investigation has been carried out to study the behavior of RC and steel braced RC frames. Multi-storied buildings have been analyzed with and without bracings.

The following conclusion can be drawn based on the results of the analysis carried out. 1. The displacement of the building decreases depending upon the different bracing system employed and the bracing sizes. 2. Comparing to bare frame all braced models have less displacement. The building frames with X bracing system in X-X direction (steel bracing) have less/minimum displacement in comparison with other bracing system in same direction that is about 90% of the displacement is reduced. This may be due to increased flexibility of steel compared to concrete. From this it can be concluded that the steel X bracings is more effective to resist lateral loads (i.e. Earthquake static and dynamic load) compared to v bracing placed in different location.

30) **T. Paulay (2008)**

Title: Ductility and Energy Dissipation in Braced Structures

Explanation: The study explains that **ductility** is the ability of a structure to undergo large deformation without failure during earthquakes.

Braced structures improve seismic performance by increasing **strength and stiffness**.

Energy dissipation occurs through **yielding of braces and joints**, which helps reduce earthquake forces.

Proper **design and detailing of bracing systems** are essential to avoid brittle failure.

The research highlights that **well-designed bracing systems can absorb and dissipate seismic energy effectively**, improving overall safety.

- Conculsion : Braced structures are highly effective in **resisting earthquake forces**.
- **Ductility and energy dissipation** are key factors for seismic safety.
- Properly designed bracing systems **reduce damage and prevent sudden collapse**.

Therefore, incorporating ductile bracing systems is essential for **safe and economical structural design in seismic regions**.

3. Methodology

1. To study IS code- IS456, IS 875 I, II, III and IS 1893.
2. To study the material properties which are used in building i.e. cement, sand.
3. To study the IS 1893:2002 for the Design base shear calculation.
4. Calculate design base shear from IS 1893: 2002 and find maximum base shear.
5. To study high rise building twisting deflection.
6. To study paper on shear wall and bracing system analysis.
7. **Selection of building:**
   - A G+10 commercial building.
   - Bays 3 × 3 bays (5m each). Regular and Irregular RCC building structure.
8. **Selection of Material Properties:**
   - Concrete Grade M30 and Steel Grade Fe500 has to be considered for all the RCC building (Regular and Irregular RCC building structures).

9. Load Calculation:

- Dead load – Is code 875 (part 1)
- Live load – IS code 875 (part 2)
- Wind load – IS code 875 (part 3) just for comparison
- Earthquake load – IS code 1893:2016

10. Seismic Parameters Selection and base share calculation:

- Different Seismic parameters as follows has to be considered to calculate base shear of all Regular and Irregular RCC building structures as per IS 1893:2002 guidelines.
- Seismic Zone (Z), Design horizontal seismic coefficient (A_h) and Seismic weight of the structure (W).

11. Model preparation for the analysis

A. Regular Building

- **Model 1: Bare RCC Frame:-** No shear wall and No bracing
- **Model 2: RCC Frame with Shear Wall at Core:-** Shear walls around lift/staircase core
- **Model 3: RCC Frame with Shear Wall at Building Corners**:- Shear walls at all four corners
- **Model 4: RCC Frame with Diagonal Bracing :-** RCC X-bracing provided in exterior bays
- **Model 5: Combined System:-** Shear walls at core + diagonal bracing

B. Irregular Building

- **Model 1: Bare RCC Frame:-** No shear wall and No bracing
- **Model 2: RCC Frame with Shear Wall at Core:-** Shear walls around lift/staircase core
- **Model 3: RCC Frame with Shear Wall at Building Corners**:- Shear walls at all four corners
- **Model 4: RCC Frame with Diagonal Bracing :-** RCC X-bracing provided in exterior bays
- **Model 5: Combined System: -** Shear walls at core + diagonal bracing

12. Different parameter as follows has to be study on the basic of model:-

- To study the analyse of effect of the shear wall positioning on lateral displacement of structure.
- To study the performance of different RCC bracing system under seismic loading .
- To study seismic behaviour of RCC multi-storey building .
- To study comparison of structural response in terms of storey displacement ,base shear member force.
- To study most effective configuration of shear wall and bracing system for improving structural , stability , strength and safety.

4. REVIEW ON ETAB & STADPRO SOFTWARE

- The RCC G+10 building models will be analysed using STAAD Pro and ETABS software.
- Both software tools will used to simulate realistic seismic behaviour of the structure.

- Key parameters such as base shear, storey displacement, and storey drift will be calculated.
- ETABS helps in detailed multi-storey building analysis, especially for lateral load effects.
- STAAD Pro supports structural modelling and comparison of different system configurations.
- Base shear indicates the total seismic force acting on the building.
- Storey displacement shows the lateral movement of each floor under loading.
- Storey drift represents the relative movement between adjacent floors.
- These results help in comparing bare frame, shear wall, bracing, and combined systems.

5. EXPECTED CONCULSION

1. Steel bracing is an effective method used to strengthen and retrofit existing structures without major changes to the building system.
2. It can be used as an alternative to other retrofitting techniques because it does not significantly increase the overall weight of the building.
3. Steel bracings reduce the bending and shear forces in beams and columns by transferring lateral loads mainly through axial action.
4. Among different types, X-bracing systems are particularly effective in controlling lateral displacement of the structure.
5. Buildings with X-bracing show reduced storey drift and lower bending moments compared to other bracing configurations, improing overall structural performance.

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