TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

SEISMIC RESPONSE REDUCTION OF R.C.STRUCTURES USING MULTIPLE TYPESOF BRACING FRAMEWORK USINGSTAAD,PRO

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***Abstract*—.** Steel building has switched from moment-resistant frames to concentrically braced frames in recent years in areas of the very seismically prone country. Bracing a portion of the structural pattern by offering extra stiffness plays a critical function in structural action to withstand earthquake forces. One of the most prevalent horizontal load resistance patterns seen in building frames is concentric bracing.For this reason, seven different models that were constructed by altering the steel frame's bracing design and analysing them for wind and seismic forces In this paper, a 20-story steel frame building is investigated. This study suggests that the bracing factor will have a big influence on how structures behave when subjected to seismic loads. The Backward Bracing Pattern is the ideal bracing structure.Horizontsaldisplacementatthetopfloorisdecreasedbyapproximately50percentforBackwardbracedinframestructurecomparedtowithoutbracingpattern.

Keywords— G+7,frameloadcombination,seismiczone,ndianstandardcode,Analysisofstructure, time history analysis, STAAD PRO Analysis And Design Of Structure, Staad Pro, Seismic Reduction, Type Of Bracing Using Framework.

INTRODUCTION

On Earth, people' basic needs are for food, clothes, and shelter. Prior to the development of shelters, early humans relied on living in trees to protect them from natural disasters like rain, cold, and other threats as well as attacks by wild animals. As knowledge increased and communities were formed to provide extra protection, man quickly evolved into a social animal. Now, these towns grew and began to explode, generating villages that subsequently expanded into cities and turned into the economic hubs of an area. There was soon no more room for horizontal expansion within these business hubs. The social animal began to grow vertically, building multistory buildings. Bracing systems are one such development that has been incorporated to structures.

a braking system.

LITERATUREREVIEW

1.Rahai A.R. and AliniaM.M. The behaviour of composite bracings was researched by Rahai A.R. and Alinia M.M. First, the behaviours of many braced frames under cyclic loads were investigated. Then, using the information from the first section, two pre-existing concrete structures—a three-story building and a nine-story structure—were chosen and strengthened against seismic loadings using both the earlier composite bracing method and traditional concentric steel bracing diagrams, initial stiffness, and ultimate capacities of various models.

2 .Ozel A.E. and Guneyisi E.M. [2] Through fragility analysis, it was determined if a mid-rise reinforced concrete (R/C) structure that had been retrofitted with eccentric steel bracing was seismically reliable. A six-story, mid-rise R/C structure was chosen as the case study. The 1975 edition of the Turkish Seismic Code was used in the design of the chosen model building. In order to refit the structure, several eccentric steel bracing types were tested for efficacy. On the seismic performance of the retrofitted structure, the impact of dispersing the steel bracing throughout the height of the R/C frame was investigated.

3.Brunesi E. et.al. [3] worked on high-rise mega-frame prototypes with outriggers and belt trusses' seismic response. European standards were followed in the construction of thirty- and sixty-story planar frames three-dimensional buildings with an internal symmetric bracing core. A concentrically braced frame structure made up the core, and outriggers were positioned every fifteen floors to prevent second order effects and inter-story drifts. numerical models that may take into consideration geometric and material.

Using mechanical idealisations to simulate the behaviour of bolted beam-column and welded gusset-plate connections and inelastic force-based fibre components to describe structural parts, nonlinearities were created inside an open source platform.

4. Chou C.C. et.al [4] Through a series of cyclic tests, the structural properties of big dual-core self-centering braces (DC-SCBs) and sandwiched buckling-restrained braces (SBRBs) were investigated. The DC-SCB exhibits a self-centering mechanism and has a flag-shaped hysteretic response with high axial stiffness and little residual deformation. The DC-SCB cannot dissipate nearly as much energy as an SBRB, but SBRB-equipped buildings are predicted to experience bigger residual deformations. To assess their durability and cyclic behaviour, three SCBs and SBRBs with maximum axial forces ranging from 1500 to 6000 KN

were tested. These tests have generally demonstrated strong cycle performances with high deformation capacity and durability for the DC-SCB and SBRB..

5. Moghaddam H. [5] a method based on the idea of uniform distribution of deformation for optimising the dynamic response of concentrically braced steel frames subjected to seismic stimulation. An iterative optimisation process has been used to get the ideal distribution of structural characteristics. This method involves changing the structural characteristics to progressively move wasteful material from strong to weak regions of a structure. This cycle is repeated until uniform deformation is attained.

6. Safarizkia H.A. et.al [6] sought to assess whether the installation of steel bracing may potentially improve the seismic performance of an existing reinforced concrete building (the 5th Building of UNS Engineering Faculty). For the purposes of the study, three seismic evaluation techniques are used, namely the dynamic time history analysis in accordance with the Indonesian Code of Seismic Resistance Building (SNI 03- 1726-2002) criteria and the Improvement of Nonlinear Static Pushover Displacement Coefficient Method as described in FEMA 440. According to the findings, the goal displacement calculated from nonlinear pushover analysis of the current building is 0.132 m in the Y direction and 0.188 m in the X direction. Additionally, dynamic time history analysis reveals that the narrative of the upgraded.

7. Khandelwal K. et.al. [7] Using verified computer simulation models, we examined the progressive collapse resistance of seismically built steel braced frameworks. Special concentrically braced frames and eccentrically braced frames are the two forms of braced systems that are taken into consideration. By using the alternate path approach, the study was carried out on 10-story prototype structures that had already been planned. This approach examines the model's capacity to successfully absorb member loss by immediately removing crucial columns and any neighbouring braces that may have been present from an analysis model. It was anticipated that the removal of the member in this way would depict a scenario in which the member is destroyed by an extreme event or abnormal load..

8.Sarnoa L. D.andElnashai A.S. [8] examined how steel moment resistant frames (MRFs) modified with various bracing techniques performed during earthquakes. Special concentrically braces (SCBFs), buckling-restrained braces (BRBFs), and mega-braces (MBFs) were the three structural designs that were used. In zones with significant seismic danger, a 9-storey steel perimeter MRF was built with lateral stiffness insufficient to fulfil code drift constraints. Then SCBFs, BRBFs, and MBFs were retrofitted to the frame. For the purpose of evaluating the structural performance under earthquake ground vibrations, inelastic time-history studies were performed. To compare the inelastic response of the modified frames, local (member rotations) and global (inter-storey and roof drifts) deformations were used. However, the lateral drift reductions depend on the features of seismic ground movements, particularly frequency content. Configurations with buckling-restrained mega-braces have somewhat better seismic performance.

9. Foutch D. A. [9] used large-scale testing facilities to conduct experiments on a full-scale eccentrically braced dual frame building as part of the U.S.-Japan Cooperative Earthquake Research Programme. Based on the 1979 and 1982 UBC requirements, the building's strength exceeds its design capacity by roughly three times. Although the bottom three storeys of the building absorb the majority of the energy, the structure has great ductility and energy absorption capabilities. Although the building's extra strength contributes to its great behaviour, it also causes some connections to break before they should and causes significant uplift forces in the columns of the braced bay.For every story above the first, the ratios stayed largely the same. The bracing in the first storey carried extra weight during the last cycle of the sinusoidal testing.

10. Ghobarah A. and Elfath H. A. [10] examined the seismic performance of a low-rise eccentric steel-braced non-ductile reinforced concrete (RC) building. Several ground motion data were used to analyse a three-story office building. It was investigated how well the eccentric steel bracing restored the structure. On the seismic performance of the renovated building, the impact of dispersing the steel bracing throughout the height of the RC frame was investigated. A beam-column element that can simulate the strength degradation, the impact of the axial force on the yield moment, and the deformation capacities at peak strength of the members accurately depicts the behaviour of the non-ductile RC frame members. Tri-linear moment and shear force representations are used to model the behaviour of the links.

11. Hjelmstad K. D. and Popov E. P. [11] steel frames with eccentric bracing have been studied for their effectiveness in minimising structural damage during earthquakes. The two used experiments to verify their findings. They have selected two structures with three and six stories each for this. However, the team first put the suit into use on a one floor, single bay frame before conducting field tests. The relative bending, shear, and axial stiffness of the members (EI, GA', and EA, respectively) may be used to represent the lateral stiffness for the basic system.

E and G stand for elastic modulus, I for moment of inertia, A for total area, and A' for shear area, respectively, together with the topological parameters e/L and h/L. They came to the conclusion that moment-resisting frames are less effective than eccentrically braced frames in meeting drift control criteria.

12. Maheri M. R. and Sahebi A. [12] The use of steel bracing in concrete-framed constructions was examined. A series of experiments on various model frames are used to carry out the investigation. The experiments' main goals were to ascertain how well various diagonal bracing configurations increased the concrete frame's in-plane shear strength as well as to evaluate the relative behaviour of tension and compression braces. The connection between the steel braces and the concrete frame was given the appropriate amount of priority. The test results show that the steel bracing significantly increases the frame's in-plane strength. Overall, it is observed that steel bracing might be a suitable replacement for or addition to wood bracing if the brace and the frame are properly connected.

13. Roeder C. W. [13] carried performed seismic testing

on a six-story steel skyscraper in full scale as part of the joint research programme between the United States and Japan. Extensive experiments on a concentrically braced frame are part of the research's initial phase, and the findings of these testing are given in detail. For elastic, moderate, and final testing, the concentrically braced frame is put to the test. The structure is elastic during the test, which simulates a tiny, regular earthquake. An earthquake of moderate size is simulated by the moderate test. At the second floor brace beam splice, there is unique three-piece beam web damage and little yielding and brace buckling. This uncommon failure is examined and contrasted with American design standards. The last test replicates a powerful earthquake with significant bracing giving and buckling.

14. Wei X. and Bruneau M. [14] In order to offer bi-directional resistance, studied ductile end diaphragm systems (EDSs) with Buckling Restrained Braces (BRBs) arranged in two distinct bidirectional configurations were installed in the slab-on-girder bridge superstructure. Ductile diaphragms can be designed as Permissible Earthquake-Resisting Elements (EREs) to resist seismic stresses applied to bridges in their transverse direction, according to the AASHTO Guide Specifications for Seismic Bridge Design. To address seismic excitations acting along the bridge's longitudinal axis, other lateral-load resisting strategies must be combined with the transverse ductile diaphragms. Additionally, the current AASHTO provisions (reflecting the limitations of available research) only apply to straight bridges and offer no guidance on how to implement ductile diaphragms in skew bridges Benchmark.

15. Montuori R. et.al. [15] examined how the bracing scheme affected the seismic performances of Moment Resisting Frames-Eccentrically Braced Frames (MRF-EBF) dual systems that were designed using two different design approaches: the first was based on the Theory of Plastic Mechanism Control (TPMC), and the second was based on Euro Code 8 (EC8) design requirements. Although the TPMC design approach is not included in current seismic codes, it has developed a solid theoretical foundation based on the kinematic theorem of plastic collapse extended to the collapse mechanism equilibrium curve to guarantee a collapse mechanism of global type, earning it the reputation of being a reliable design approach. On the other hand, the EC8-based design methodology encourages the use of the so-called beam-column hierarchy criteria, which is typically capable.

16. Qiu C.-X. And Zhu S. [16] Pushover and incremental dynamic studies were used to numerically examine multi-story steel frames with self-centering braces (SCBs) that are seismic-resistant. With a focus on the high-mode effect, the seismic performance of self-centering braced frames (SC-BFs) and buckling-restrained braced frames (BRBFs) is carefully examined. This consequence makes SC-BFs more relevant than BRBFs in terms of the concentration of inter-story drift in the top section of the structures. The severity of the ground movements increases the strength of this high-mode impact. According to parametric studies, SC-BFs may successfully enhance their seismic performance by boosting their post-yield stiffness ratio and/or energy dissipation capacity, especially when it comes to reducing the high-mode effect. The inter-story drift ratios of SC-BFs with improved post-yield stiffness and energy dissipation capability are essentially consistent, and record-to-record variability is decreased.

17. M. S. Speicher et.al. [17] developed and experimentally tested an articulated quadrilateral (AQ) bracing system based on shape memory alloy (SMA) for applications requiring seismic resistance. The system offers reentering and damping in a scalable configuration. The cornerstone of the bracing presented herein is the ability to modify the energy dissipation in a reentering hysteretic loop through the use of an AQ arrangement, which is motivated by SMA's exceptional capacity to recover stresses of up to about 8% by diffusion less phase transition. The articulated quadrilateral arrangement offers a straightforward way to combine nickel-titanium (NiTi) wires with energy dissipation devices that is scalable, customizable, and easy to use. This arrangement produces a system with customizable damping and re-centering that may be used to a variety of both new and old structures. These prototype experiments utilisedNiTi

18. Tremblay R., et.al. [18] Two, four, eight, twelve, and sixteen storey steel framed structures with self-centering energy dissipative (SCED) bracing members had their seismic response mathematically examined. The SCED bracing member can use self-centering devices, such as those that demonstrate a flag-shaped hysteretic response, to eliminate residual drift. Studies comparing SDOF systems with equivalent elastic-plastic systems (with the same strength and stiffness properties) revealed that, when adequate energy dissipation capacity is offered, these systems can match or even outperform those systems' responses in terms of displacement demand without experiencing any residual drift. Braced steel frames are anticipated to perform well under mild and moderate earthquakes due to their enhanced elastic stiffness. However, narrative drift and inelastic response demand in braced frames tend to focus on a small number of stories.

19. Youssef et al. [19] focused on evaluating the performance of steel-braced buildings with reinforced concrete frames. An experimental study assessed the effectiveness of
X-brace element made of metal. In compliance with the International Building Code (IBC) and ACI 318-02, two RC frames were modelled, one with moderate ductility and the other with bracing. On both the braced frame and the moment-resisting frame, two cyclic load tests were performed. The RC frame included four storeys. Gusset plates that had been joined together served as the means of attaching the bracing to the RC frame. The cast specimen underwent a pushover study, and the findings showed that bracings lowered the ductility demands on the main structural components. At a weight of 45 kN, the bare frame begins to give, and at a load of 55 kN, it fails.

20. Sarno and Elnashi [20] examined how steel moment-resisting frames and frames with bracing systems performed during earthquakes. Special Concentrically Braces (SCBF), Buckling Restrained Braces (BRB), and Mega Braces (MBF) are the three different types of bracing systems that are employed. In order to avoid violating the code drift restrictions in high seismicity zones, a nine-story steel structure was modelled with insufficient lateral stiffness. The building was retrofitted with the aid of SCBFs, BRBs, and MBFs. To evaluate

the performance of the modelled structure, an inelastic time history analysis was conducted. Results that could be compared included the member's plastic rotation, inter-story drift, and roof storey displacement. Results showed that the Mega Brace Frame's roof storey displacement is 70% less than that of Moment Resisting

21. Valente [21] examines the effectiveness of a novel type of bracing system numerically in seismically active areas. The researcher's suggested bracing system consists of a ductile shear panel fastened by bolts to the 'I' section short bracing at each of the shear plate's four corners. Although the bracing are not intended to display ductile behaviour, the shear plate does so well. The frames with shear panels and concentric X bracing are designed using an energy-based design process. A four-story RC structure that was only intended to support gravity loads was used to assess the performance of the bracing system. On the proposed structure, a nonlinear dynamic analysis was performed by applying seven accelerograms. The top storey displacement, interstorey drift, and energy dissipation capacity were used to summarise the results.

22. Moghaddam et al. [22] On the basis of the idea of uniform distribution of deformation, research has been done on a novel method for optimising the dynamic response of concentrically braced steel frames subjected to seismic excitation. This process involves changing the structural characteristics such that the ineffective material is moved from the strong zone to the weak zone, and it is repeated until uniform deformation is achieved. Three steel structures with story variations of 5, 10, and 15 were modelled for analytical purposes using concentric steel bracing. With a PGA of 0.44g and the building being located in seismic zone 4 of UBC, all connections are thought to be straightforward. A nonlinear static and dynamic analysis was performed using.

23. Bahey and Bruneau [23] used the idea of a structural fuse to fix bent reinforced concrete bridges. The investigation's goal was to maintain the bridge piers elastic by deforming the structural fuse in an inelastic manner. This ground-breaking method might be used for retrofitting both brand-new buildings and existing ones. Braces made of mild steel that may buckle were employed as a structural support. The modelled structure was examined using nonlinear dynamic time history analysis. The use of graphics in the search for an acceptable solution demonstrates the need for larger fuse elements as frame strength rises to obtain a structural fuse idea that is successful. The idea of a metallic fuse might be improved by using a different bracing technique.

24. Shen et al. [24] invented the idea of controlled tube-in-tube buckling bracing for use as a structural fusion. Two tubes make up this assembly: the inner tube carries the axial stresses, while the peripheral tube regulates the buckling of the inner tube. Gusset plates were used to join the square outer tube to the circular inner tube. The entire product adhered to ASTM standards. In order to examine nonlinear static analysis, Newton Raphson technique was applied on ABACUS software, and only material nonlinearity was incorporated to represent material inelastic property. The three elements of gap, friction, and stiffness between the loads carrying tube and buckling control were the main focus of the parametric investigation. The study found that the distance between the two tubes is.

25. Ma and Yam [25] introduced the idea of a self-centering damper. This damper is made up of two parts: the energy-dissipating component group and the re-centering component group. In contrast to the energy dissipation group, which consists of internal shaft, external tube, two groups of pre-tensioned shape metal alloy (SMA) wires, and three anchors, the re-centering group is made up of internal shaft, external tube, two pre compressed springs, and two shim plates. A novel approach to mathematical modelling is suggested using the Bouc-Wen model. This entire idea was implemented on two steel-framed structures while they were being shaken by earthquakes. Using Matlab, a nonlinear time history analysis was performed.Software for Simulink programming. When comparing the findings, the inter-storey drifts were reduced by 33% and 35%, respectively.

26.Ghobarah and Elfath [26] undertook research on the repair of reinforced concrete buildings using eccentrically braced frames. An investigation was conducted on a low-rise, reinforced concrete structure. The eccentrically braced frame link is crucial because it gives the structural ductility, leaving the principal members and braces in the elastic range. However, RC beams are not ductile enough to serve as a connection, thus the model includes a vertical steel link. Three different bracing systems were employed to construct a three-story RC building model. The first ones are distributed inverted V with ductile vertical link, inverted V with ductile vertical link, and inverted V bracing. The American Concrete Institute's (ACI) code was used in the design of the chosen building.

IMPORTANTFINDINGS

1. A G+7 storey reinforced concrete (RC) moment resistant frame in zone IV is simulated in the current study to evaluate the idea of a metallic fuse. Concentric type bracing, which is modelled as a fuse element, is applied to structures.
2. Four different bracing systems make up concentrated bracing. Nonlinear dynamic time history analysis is carried out using the SAP-2000 programming language.
3. analysis to evaluate a concept. To evaluate the efficacy of the building construction, both approaches must be applied.
4. The primary justification for non linear analysis is that it gives researchers a wider perspective on what happens to the structure when the produced earthquake exceeds the elastic limit, whereas linear analysis does not provide a comprehensive understanding of the structure.

CONCLUSION BASED ON LITERATURE REVIEW

1. A number of researchers have looked at the idea of a metallic fuse and have conducted experimental and analytical study employing metallic dampers, bracing systems, and buckling restrained braces as metallic fuse elements.
2. The sorts of braces known as buckling restrained braces are those that do not buckle when axial compressive force is applied to them to reduce buckling. For the assessment of concepts, almost all scholars have employed either the pushover approach or nonlinear dynamic time history analysis..

3. Both methods must be used to assess the effectiveness of the building construction. Non linear analysis is mostly used since doing linear analysis does not provide complete insight into the structure. Researchers can gain a more comprehensive understanding of what happens to the structure when the produced earthquake surpasses the structure's elastic limit by using non linear analysis. When the earthquake excitation surpasses the elastic limit of the relevant structure, non linear dynamic time history analysis allows researchers to locate storey displacement, storey drift, shear force, and bending moment in crucial column members.

4. One can determine a structure's maximum shear resisting capability by doing a pushover study. It also makes it possible to identify the structural point of failure, from which the yield shears and yield displacement may be computed. It is possible to analyse the structure's ductility, which is a crucial factor in determining how well it will hold up during an earthquake.

5. Pushover analysis also makes it simple for researchers to identify the real response modification factor of their constructions, allowing them to ascertain the true strength the structure possesses.

6. Non Finding the sequential creation of hinges inside the structure may also be done with the use of linear static analysis.

Researchers only used one kind of bracing configuration to the relevant structure; however, applying other configurations would aid in identifying the most efficient one.

7. Consequently, the current work will be carried out with various bracing designs with.

MODELING OF BUILDING FRAMEGENERAL

The simplest and quickest method of minimisingbuilding response is using metallic bracing, which gave rise to five models for the study.

1. G+7 story Reinforced Concrete Frame Without Bracing System, Model I
2. G+7 story Reinforced Concrete Frame with IV Bracing System, Model II.
3. The Model III - G7RCFWXBS is a G+7 story Reinforced Concrete Frame with an X Bracing System.
4.Model IV, G+7 story Reinforced Concrete Frame with V Bracing System.
5. Model V- G7RCFWEBS G+7 story Reinforced Concrete Frame with Eccentric Bracing System:

The inverted V (IV), X, V, and Eccentric Braced Frame configurations of the concentric bracing system are included in Models II, III, and IV. Because eccentric bracing systems have a link part that experiences inelastic deformation for energy dissipation, this bracing system is employed. This connection may be a beam component of a frame construction, which works better for steel structures than reinforced concrete ones.

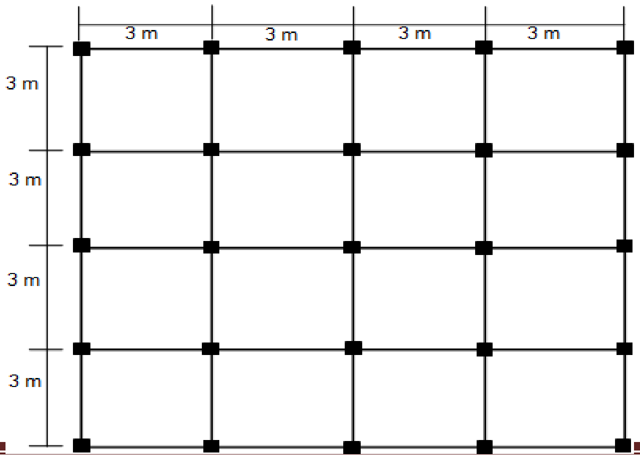

Figure 1.1: Typical Plan of Modeled Building

NonLinearDynamicTimeHistoryAnalysis

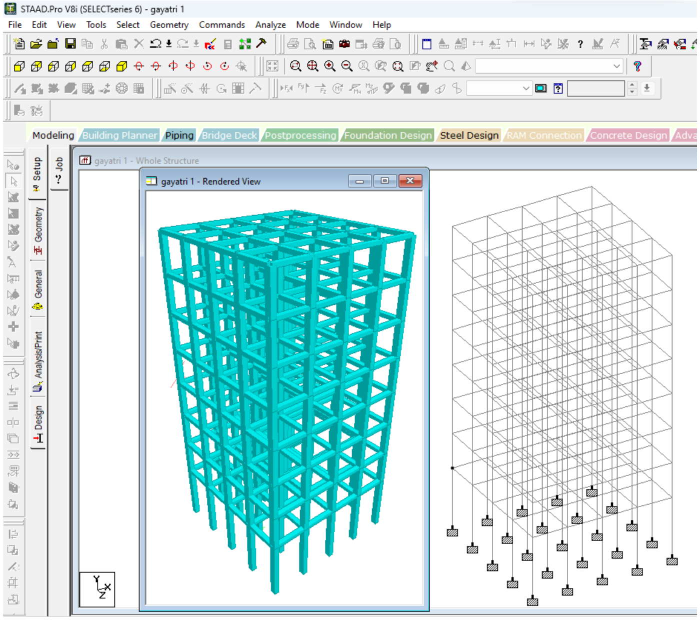

Figure 1.2: 3-D STAAD Pro V8i Modeled Building

Figure1.2 above top illustrates the G +7 Simple Building model in Staad pro V8i. This reinforced concrete building has columns and beams that are each 300 x 400 mm in size and is made of high-density steel Fe415 and concrete of the M20 concrete grade. to investigate how well bracing systems affect a building's reaction.

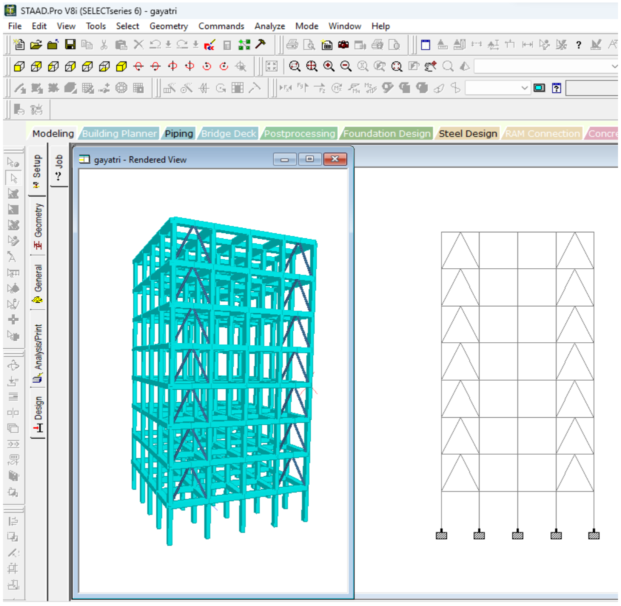

Figure 1.3: 3-D and Elevation View of Inverted V (Chevron) Braced Frame Structure

The G+7 Building with Eccentric Bracing System Model in STAAD Pro V8i is shown in picture 1.3 above. This reinforced concrete building has columns and beams that are each 300 x 400 mm in size and is made of high-density steel Fe415 and concrete of the M20 concrete grade. Which two diagonal corners of the column are connected by an ISMB 125 (Mild Steel) diagonal member for the corner bay. G+ 7 story Reinforced Concrete Frame with IV Bracing System is how this type is identified. (G7RCFWIVBS).

EffectofBracingonStoreyDisplacement

Tables 1.1 to 1.4s show the storey displacement that occurred at various storey's for various bracing patterns. For earthquakes of four different intensities, the table compares the impact of bracing on displacement of each floor with bare frame.

Table: 1.1 For Imperial Valley Time History, displacements happened at various stories with varying bracing patterns.

Displacements (mm)						
Earthquake Time History	Storey No.	Bare Frame	EB Brace Frame	IV Brace Frame	X Brace Frame	V Brace Frame
Imperial Valley	1	0.0	0.0	0.0	0.0	0.0
	2	44.0	28.6	15.6	14.1	27.3
	3	113.9	68.8	38.9	35.2	67.1
	4	183.7	109.9	63.0	58.6	107.6
	5	245.2	149.7	86.2	82.9	146.3
	6	299.4	185.8	107.4	106.6	181.3
	7	343.7	215.9	125.5	128.3	211.0
	8	375.7	238.8	139.6	146.9	234.2

Tables 1.1

The maximum top displacement caused by the Imperial Valley earthquake is shown in

Table 1.1 for each test level of the bare frame, EB brace frame, IV brace frame, X brace frame, and V brace frame. For this earthquake, the bare frame (375.7 mm) and the IV brace frame (139.6 mm) and X brace frame (146.9 mm) models significantly reduce the top displacement of the building.

Table: 1.2For the Kern Time History, displacementsharpened at various stories with varying bracing patterns.

Displacements (mm)						
Earthquake Time History	Storey No.	Bare Frame	EB Brace Frame	IV Brace Frame	X Brace Frame	V Brace Frame
Kern	0	0.0	0.0	0.0	0.0	0.0
	1	21.6	15.2	6.1	5.1	14.6
	2	55.5	34.4	15.0	12.8	33.5
	3	87.2	50.3	24.2	21.5	48.7
	4	114.5	61.3	33.2	31.0	58.6
	5	135.8	67.7	41.4	40.6	67.0
	6	153.2	76.9	48.6	49.6	81.1
	7	167.2	92.8	54.4	57.7	95.0

T
a
b

Tables 1.2

The maximum top displacement caused by the Kern earthquake is shown in

Table 1.2 for each story level of the Bare Frame, EB Brace Frame, IV Brace Frame, X Brace Frame, and V Brace Frame. In comparison to the bare frame (167.2 mm), the IV brace frame (54.4 mm) and X brace frame (57.7 mm) model efficiently reduce the top displacement of the building.

Table: 1.3 For the Loma Prieta Time History, displacements happened at various stories with varying patterns of bracing.

Displacements (mm)						
Earthquake Time History	Storey No.	Bare Frame	EB Brace Frame	IV Brace Frame	X Brace Frame	V Brace Frame
Loma Prieta	0	0.0	0.0	0.0	0.0	0.0
	1	23.8	18.7	12.8	10.7	17.9
	2	60.8	44.8	31.4	26.2	43.4
	3	97.5	70.7	50.1	42.9	69.1
	4	129.5	95.0	67.7	59.6	93.8
	5	154.8	116.7	82.9	75.3	116.6
	6	172.4	136.0	95.4	89.6	136.5
	7	183.0	151.4	105.3	101.7	152.9

Tables 1.3

The maximum top displacement of the Bare Frame, EB Brace Frame, IV Brace Frame, X Brace Frame, and V Brace Frame at each story level as a result of the Loma Prieta earthquake is shown in

Table 1.3. When compared to the bare frame (375.7 mm), the IV brace frame (105.3 mm) and X brace frame (101.7 mm) model efficiently reduce the building's top displacement.

Table: 1.4 For North Ridge Time History, displacements happened at various stories with varying bracing patterns.

Table 1.4 shows maximum top displacement at each story levelofBareFrame,EBBraceFrame,IVBrae Frame, X

Displacements (mm)						
Earthquake Time History	Storey No.	Bare Frame	EB Brace Frame	IV Brace Frame	X Brace Frame	V Brace Frame
North Ridge	0	0.0	0.0	0.0	0.0	0.0
	1	3.7	2.4	1.9	2.1	2.4
	2	9.7	5.6	4.6	5.2	5.5
	3	15.5	8.6	7.5	8.5	8.2
	4	20.4	11.6	10.3	11.9	11.0
	5	24.5	14.2	12.8	15.0	13.6
	6	27.9	16.8	14.9	17.7	16.1

	7	30.2	19.3	16.6	20.1	18.4

Tables 1.4

Under the effect of the North Ridge earthquake, brace frames and V braces. For this earthquake, every brace frame type significantly reduced the building's top displacement as compared to a bare frame (30.2 mm).

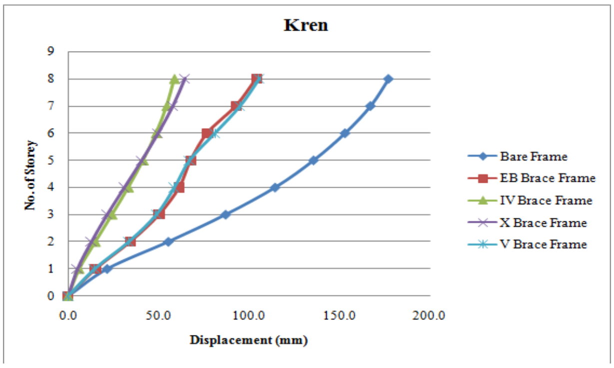

Figure 1.4

Figure 1.4: Comparison of displacement for the Imperial Valley earthquake's bare frame and braced frame models.

Figure 1.4 diagrammatically displays Table 1.1. Here, we can see that, in comparison to the bare frame, the building's top displacement is greatly decreased by the IV and X bracing system.

Displacement comparison between the bare frame and braced frame models for the Kern earthquake is shown in Figure 1.4.

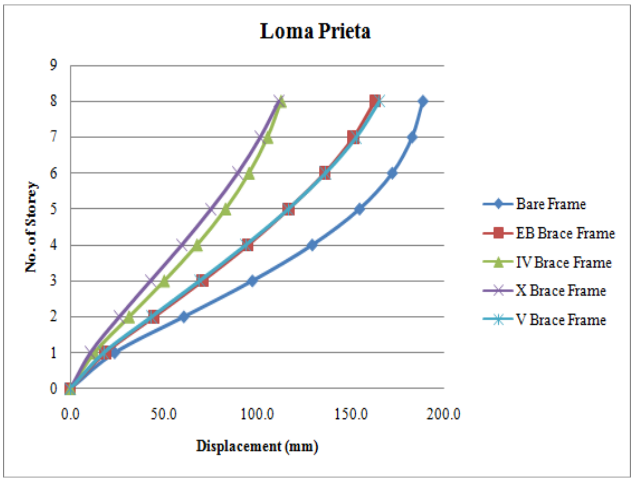

Figure 1.5.

Figure 1.5 shows the displacement comparison for the Loma Prieta earthquake's bare frame and braced frame models.

Figure 1.5 shows a diagrammatic representation of Table 1.3. Here, we can see that, in comparison to the bare frame, the building's top displacement is greatly decreased by the IV and X bracing system.

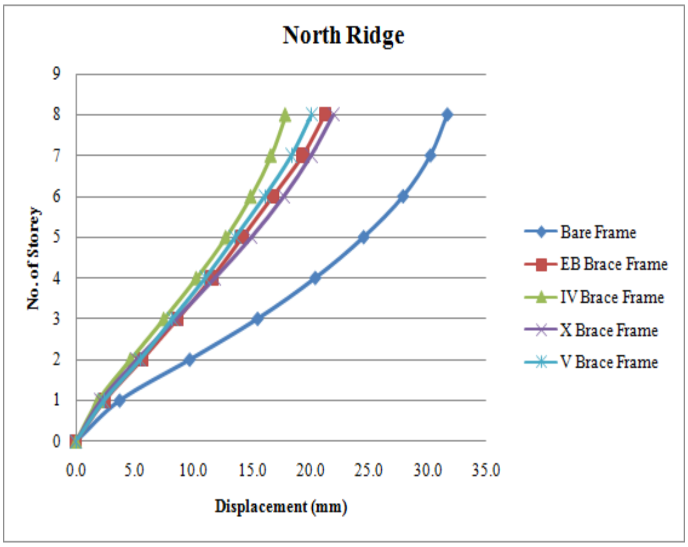

Figure 1.6

Comparison of displacement for the North Ridge earthquake's bare frame and braced frame models
Diagrammatic form of Table 4 is shown in
Figure 1.6. Here, we can see that the building's top displacement for the entire bracing system is significantly reduced as compared to the bare frame.

It is possible to study the impact of bracings using tables and storey displacement numbers. It has been shown that adding varied bracing patterns to bare frame structures lowers the displacements at each storey level, significantly lowering the displacement at the top storey. It was evident from the table that, for the earthquakes in the Imperial Valley, Kern, Loma Prieta, and North Ridge, simulating an eccentrically braced frame reduced top storey displacement by 36.43%, 44.49%, 17.26%, and 36.09%, respectively. Similarly, for the same sequence of Chevron braced frames, top storey displacement is reduced by 62.48%, 67.46%, 42.45%, and 45.03%.

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