SEISMIC ANALYSIS OF A HIGH-RISE BUILDING FRAME WITH AND WITHOUT SHEAR LINKS OF DIFFERENT MATERIALS CONCEPTUAL REVIEW

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Abstract - *Tall building development involves various complex factors such as economics, aesthetics look, technology, municipal regulations, and politics. Among these, economics has been the primary governing factor. For a very tall building, its structural design is generally governed by its lateral stiffness. Comparing with conventional orthogonal structures for tall buildings such as framed tubes, vertical shear link enhanced structures carry lateral seismic loads much more efficiently by their diagonal member's axial action. A shear link structure provides great structural efficiency to minimize stress concentration of a structure with bracings. A shear link structure is a type of structural system consisting of bracings connected through horizontal rings which create an elegant and redundant structure that is especially efficient for high-rise buildings. A vertical shear link structure is different from braced frame systems, since shear panel is vertically installed at joints of bracing as main structural elements participate in carrying gravity load in addition to carrying lateral load due to their configuration.*

Key Words: Shear link, Seismic analysis, Multistory

1. INTRODUCTION

It would be challenging to address here the entire body of literature on bracings and shear links in detail. Despite the fact that a lot of work has been done modelling braced systems in reinforced concrete structures, from analysis assumptions to design recommendations, none of it provides a comprehensive understanding of the seismic response of reinforced concrete (RC) buildings contributions related to shear link and previous efforts most closely related to the needs of the present work. Here is a brief summary of earlier studies' findings regarding the shear link in braced systems and code provision. The bracing systems used in reinforced concrete structures are the focus of this literature review, and specific code provisions will be discussed in each section.

2. CONTRIBUTION OF RESEARCHERS

Akshay Sonawane et. al. (2016), focuses on the effect of bracing system on the storey that is critical in the structure. They studied on bracing systems like cross bracing, diagonal bracing, inverted V bracing and V bracing systems and results on components like storey drift and bending moment in columns and storey displacement were calculated.

Omprakash et. Al. (2016) Studied the effect of bracings on a composite structure with x- type bracing with different material and concluded that x bracing with steel material on midrise building provide good resistance to lateral forces.

Vishwanath B. Patil (2016), studied on stability analysis of multistory building with underneath satellite bus stop having Service soft storey and floating columns. In this investigation, the study of analysis of columns, shear walls, coupled component, single and multistory structure was done. For the stability of the building, arrangements like bracing system and shear system is provided or combination of both was used. The stability analysis was done in the computer software like STAAD Pro and ETAB/SAP 2000 with addition of P-Δ analysis. They concluded that, when lateral stiffness decreases, there was reduction in extreme frame building loads and square columns gives better result in parameters like storey drift, base shear and roof displacement as compared to rectangular column.

Ranjit V. Surve et. al. (2015), analyzed the multistoried building with soft storey at different levels. In this study, they concentrated mainly on the finding of best place in high rise structure for the soft storey with ground level as soft storey as well as they find the natural time period of multistory building. They concluded that, number of hinges reduced by shifting of soft storey to the higher level of the building. With this, displacement as well as base shear gets increased. Yield occurrence gets reduced with the shifting of soft storey at higher level and there is formation of low intensity hinges after number of pushover steps gets maximum. The result for the time period was seen that, teff gets decreased as the shifting of soft storey at higher level; it reduces from 2.571sec for 4th floor to 2.366sec for 16th floor as soft storey i.e. they conclude that soft storey gives safe result at higher level in high rise structure.

Rahul Chourasiya et. al. (2015) Studied the effect of bracings at different position of the structure and compared it with rigid diaphragm structure under dynamic loading, using analysis tool staad.pro and concluded that rigid diaphragm is comparatively more effective in reducing lateral forces also making the structure cost effective in terms of reinforcement steel.

Mahesh Bagade (2015) studied the seismic evaluation of high-rise structure by using steel bracing system. For the seismically inadequate reinforced concrete frames, the use of steel bracing systems is done for strengthening. In this study, different types of bracing systems are used, and seismic analysis is done for seismic zone III as per

IS1893:2002. Lateral displacement, storey drift, axial force and base shear are the main parameters which are studied. It was seen that; the structural stiffness was contributed by the X type of steel bracing and maximum inters Torey drift of the frames also gets reduced. The bracing system gives best results in lateral stiffness, strength capacity as well as in displacement capacity. They conclude that, reduction in lateral displacement of the structure occurs up to 65% by the use of X type of bracing system. Storey drift gets reduced in X type of bracing system. There was increase in axial force for X bracing system up to 22%.

Kiran Kamath et. al. (2015) performed a comparative study on a circular plan with different angels of diagrid are considered as 64.00°, 72.00°, 76.30° and 90.00°. the geometry of circular plan is G+36 storey tall structure with 3.6 m each floor height and 36 m diameter of lateral dimensions are provided, considering wind load as per 875 part3 and seismic zone III as per 1893 part 1. Compared the structure in terms of base shear, top storey displacement, concluded that as the angle of diagrid increases, axial rigidity of the diagonal columns decreases, time period is minimum for 72o whereas top storey displacement is minimum for angle of 64.0°.

GiuliaMilana et. al. (2015) analyzed a G+40 tall structure with Different diagrid structures were considered, namely, three geometric configurations with inclination of diagonal members of 42°, 60°and 75°, and geometry considered is 36 x 36 m in lateral dimensions, and 160 m tall structure with circular shape. In this work the consider seismic Zone IV and did pushover analysis and concluded that providing diagrid is not only making economical building but also much stable in terms of safety.

Anuj K. Chandiwala et. al. (2014) studied on seismic response of RC building with soft stories. The strong column and weak beam construction is done for the safety of building during earthquake. Because of this concept, beams yield before columns collapse. In this research, different models are analysed with soft storey for proper assessment of the stiffness of the storey. They concluded that displacement would be more at upper stories and less at lower stories.

Raut Harshalata et. al. (2014) studied the effect of steel plate shear wall on behaviour of structure. In this paper, design and analysis of steel building is done with and without steel plate shear wall. G+6 storey building for seismic zone III is studied and static analysis is done using STAAD Pro software. The main components which were fond out for the

seismic performances are bending moment, shear force, deflection and axial force and comparison is done. The effect of shear wall is also considered.

Ravi K Revanche et.al. (2014) analyzed a G+12 storey structure which consist of diagrid members, the geometry of structure consider in his study was 27 X 27 m in lateral dimensions and 48 m in height consist of 12 storey considering 4m each storey height. Modelled and analyzed the structure using analysis tool SAP2000, considering dead, live and seismic loads as per Indian Standards and conducted nonlinear analysis (pushover analysis), designed the structure as per specifications, and concluded that structure with diagrid are more stable and resistable during collapse and found more durable to counteract forces in terms of displacement.

Tejas D. Joshi (2013) studied on bracing systems on high rise steel structures. For this investigation, G+15 storied steel frame structure models with same sections and different bracing arrangements like X bracing, double X bracing, Single diagonal, K bracing and V bracings are used. STAAD Pro V8i software is used for the seismic analysis and comparison is done with different parameters. The reduction in displacement is higher in case of V bracing and K bracing compared to un-braced building due to irregularity in shape of the building. Storey drifts may increase or decrease in braced building compared to un-braced building structure.

Zasiah Tafheem et. al. (2013) studied on structural behaviour of steel building with concentric and eccentric bracing. Analysis is done due to wind load, earthquake load, dead load and live load. Different bracing types such as concentric X bracing, and eccentric V type bracings are used for the investigation using HSS sections. They concluded that there is reduction in lateral displacement as compared to un-braced building. From this study, they found that concentric X bracing gives less lateral displacement as compared to eccentric V type bracing. In presence of bracing system, the inter-storey drift reduction gets increased. Due to increase in lever arm of peripheral diagonal columns, diagrid structural system is more effective in lateral load resistance. Lateral and gravity load are resisted by axial force in diagonal members on periphery of structure, which make system more effective. Diagrid structural system provides more flexibility in planning interior space and façade of the building.

D.K. paul et. al. (2012) presented a practical implementation on a earthquake resistance building to resist nonlinear (pushover) lateral seismic forces. Retrofitting is introduced in which chevron bracing and aluminum shear link as a beam is introduced to improve its performance and concluded that with the use of bracing and shear link building becomes more responsive and capable of bearing lateral forces.

Dipti r. Sahoo et. al. (2010) presented an experimental study is conducted on a reduced- scale non-ductile RC frame to investigate the effectiveness of the strengthening system under constant gravity loading and gradually increasing reversed cyclic lateral displacements. The strengthened specimen exhibited enhanced lateral strength, stiffness and energy-dissipation potential as compared to the RC (bare) frame lateral load on the frame is allowed to transfer to the shear link through a load-transferring system consisting of a shear collector beam and chevron braces so as to cause shear yielding of aluminum plates. No extensive strengthening of the existing RC columns is carried out in the proposed technique. Concluded that the energy-dissipation and damping potential of the shear link significantly reduced the damage levels in the existing RC members of the strengthened specimen up to 3.5% drift level.

K. moon (2009) compared different stories tall structure of 60 and 80 storey heights with same lateral geometric aspects and loadings with considering diagrids of 63o, 69o and 73 o and determine that the structural efficiency of dia-grids for tall buildings can be maximized by configuring them to have optimum grid geometries. Though the construction of a diagrid structure is challenging due to its complicated nodes, its con- struct ability can be enhanced by appropriate prefabrication methods.

Kyoung-sun moon (2007) presented a comparative study on tall structures ranging from
20 to 60 stories. And compare bracings and diagrid works in terms of forces and economical sections, presenting diagrid range from 65 to 75 degrees and concluded that

3. GAP IN RESEARCH REVIEW AND OBJECTIVE OF NEW RESEARCH

The researchers have tried to find the variation in forces which occurs due to bracing system and shear link, following are the outcomes of literature review:

- Frame with bracings results in less lateral forces in beam and columns.
- Structure with links become more stable.
- Bracings in tall structures reduces the effect of storey drift.

4. CONCLUSION

From the study we can conclude that when the following structure models were considered and their seismic analysis was done, i. e frame structure with steel bracings & steel bracings with shear links. aluminium bracings & aluminium bracings with shear link, the structure aluminium bracings are found efficient in comparison to others in reducing Maximum B.M, Shear Force, Axial Force. Vertical shear links have fat and stable hysteresis loops. These components act as a minor structural member and like a ductile fuse. they dissipate the seismic energy, increase the structures ductility, and prevent the damage to the main structural elements such as beams, columns and bracing by preventing other members to reach yield point. further when aluminium and steel shear links was used B.M. were reduced used the performance of structure with aluminium bracings and aluminium shear links is best.

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