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"RESPONSE SPECTRUM ANALYSIS OF A RC COUPLED SHEAR WALL FRAME COMBINATION WITH X BRACING COMPARED WITH OTHER FRAMES IN SEISMIC ZONE OF INDIA"

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Abstract - *Earthquake is one of the most dangerous among all the natural hazards. It affects the life and property of the people drastically thus for building safety, it is essential that structures should have designed with adequate lateral stability, strength, and sufficient ductility. There are various types of structural system for lateral load resistance for reducing the effect of earthquake forces for RC buildings. The shear wall and cross bracing is one of the system used in skyscraper to enhance its structural efficiency to prevent it against the lateral loads. The two shear wall coupled with one another by coupling beams more efficiently resisting the lateral forces. In present research work, coupled shear wall in combination with steel x bracing provided in bare frame at an outer portion of the building with R.C.C beam and the slab and this frame is analyzed and compared with bare frame. The diagonal member of cross bracing take the compression and tension stresses effectively while the coupled shear wall reduces the bending moment, shear force. The structure transferred the lateral loads by axial action by which stresses reduces over the column and beams as compared to stresses developed in columns and beams in the conventional building system. For present research analysis a regular 13 storey RCC frame having square plan of size 25 m × 25 m which is located in seismic zone V is considered. For the analysis of structure STAAD.Pro software is used and the Seismic zone consideration is as per IS 1893(Part 1): 2002.*

Key Words: COMPARATIVE ANALYSIS1, SEISMIC ANALYSIS2, COBINED METHODOLOGY3, HIGH RISE BUILDING4, STAAD.PRO SOFTWARE5.

1. INTRODUCTION

In a design of skyscraper Safety, Economics, aesthetic look, technology and municipal regulations, are the major point of consideration. Among all these aspects safety and economics is the primary governing factor for designing but if we talk about the seismic resistant structure, safety have the monopoly over all the other factors. For earthquake resistant structure, lateral stiffness is totally governing the design criteria of structural design. RC coupled shear wall with x bracing in structures take the lateral seismic loads much more efficiently by diagonal member by axial action supported by the walls and reducing the other stresses like shear force, bending moment, base shear, etc. at outskirt of building as compared with ordinary structures such as RC bare frame.

1.1 COUPLED SHEAR WALL SYSTEM

The Coupled shear walls consist of two shear walls are connect intermittently by beams along the structure height. The coupled shear walls behavior is governed by the coupling beams. These coupling beams designed to dissipate energy due to inelastic behavior of structure. The yield moment capacity and plastic rotation capacity of the coupling beams is the factor on which amount of energy dissipation depends.

1.2 CROSS BRACING SYSTEM

Cross bracing system utilized in RC structures in which diagonal supports intersect. Cross bracing is usually made up of two diagonal supports placed in an X shaped manner; and these elements take compression and tension forces. Cross bracing can enhances an edifice capacity to withstand against lateral forces due to seismic activity.

1.3 COMBINE SHEAR WALL AND X BRACING SYSTEM

Combine system is a new type of system in which the coupled shear wall at each corner of the frame and cross bracing is provided at other bay of the structure. Both the system have the high capability in counter the effect of lateral forces. The combine effect of both the system will greatly influence the lateral force effect over the structure and reduces it.

2. LITERATURE REVIEW

Dipendu Bhunia, et. al. (2013) published a paper on Coupled Shear Walls Conceptual Design Approach in which they analyze a performance-based seismic design (PBSD) and compared it to conventional design based on linear response spectrum analysis. They showed that coupled shear wall offer significantly improved solutions based on the Performance based seismic design (PBSD) implies design, evaluation, and construction of engineered facilities whose performance under extreme load condition. Their main objective of PBSD is to generate structures who have a predictable seismic performance. They specified the performance criteria corresponding to multiple levels PBSD of earthquake.

Dharanya et.al. (2017) published their research worked on the analysis and comparison of shear wall and bracings system with seismic loading condition. They analyzed an edifice with soft storey having G+4 storey high. This edifice

having cross bracing and shear wall each having plan dimension of 381 m2and 3m height of each storey. The analysis done on Etabs, considering equivalent static load method for the seismic zone V only.

Dr. Mahdi Hosseini et al (2019) done research on response spectrum method of dynamic analysis of RC frame with shear walls under the effect of Seismic attack. A thirty story edifice with different shaped like C Shape, Box shape, I shape and new shape (Plus shape +) RC Shear wall is introduced at the center in Frame Structure with support of rigid condition with soft soil in earthquake zone V as per IS 1893 (part 1): 2002.Irjet Template sample paragraph .Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

3. OBJECTIVES:

1. To study the behavior of frame to the new concept of combine coupled shear wall and x bracing system.

2. To determine the variation in forces due to provision of diagonal member and shear wall on structure under seismic forces.

3. Comparison of results concluded from the analysis in terms of Max story drift, max story displacement, base shear in seismic case, time period.

Table -1: GEOMETRY & LOAD CONSIDERATION

TYPE OF STRUCTURE	RESIDENTIAL BUILDING
PLAN DIMENSION	25m X 25m
TOTAL HEIGHT OF BUILDING	39m
HEIGHT OF EACH STOREY	3m
COLUMN SIZE	700mm X 700mm
BEAM SIZE	400mm X 400mm
ANGLE SIZE	100mm X 100mm X 10mm
DEAD LOAD	IS 875 PART 1
LIVE LOAD	IS 875 PART 2
LOAD COMBINATION	IS 875 PART 5
EARTHQUAKE LOAD	IS 1893 (PART-1):2002

4. METHODOLOGY:

STEP-1. In the primary step modelling of conventional bare frame structure and combine couple shear wall and X braced frame generated in Staad software. All the structure are formed with same plan area.

STEP-2. After modelling in design load as per IS 875 and seismic forces as per Indian standard 1893-part-1 is applied over the structure in Staad.pro.

STEP-3. Relative comparative study is done on the structures to understand its behavior in helping the reduction of lateral forces

STEP-4. All the results obtained from results are plotted in graph using MS word

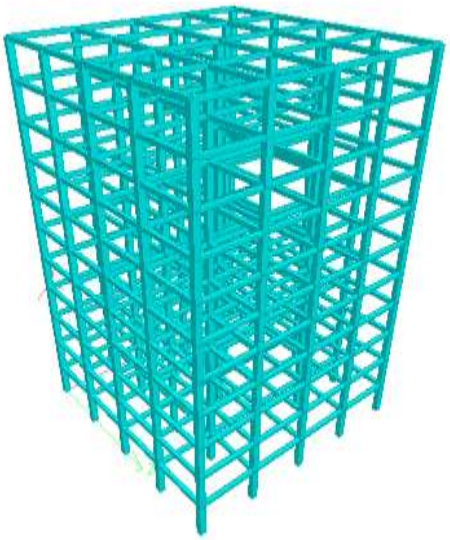

Fig -1: BARE FRAME (MODEL 1)

Fig -2: RC FRAME WITH COUPLED SHEAR WALL AND X BRACING (MODEL 2)

5. RESULTS & ANALYSIS:

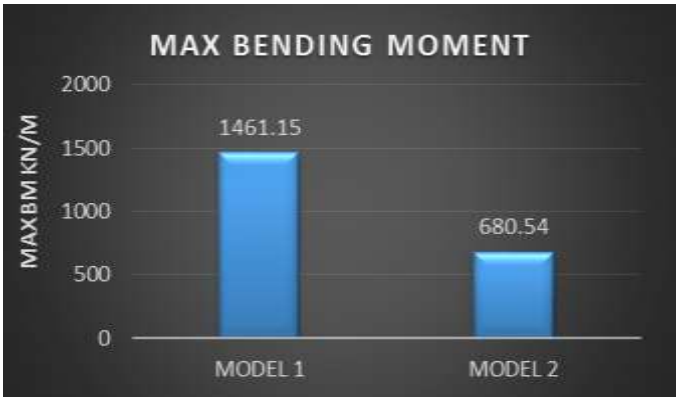

Chart -1: bending moment comparison graph

The results shows that bending moment is reducing in model 2 therefore the model 2 provides more stability than model 1.

Chart -2: shear force comparison graph

The shear force is also reducing in model 2 as evident from the graph thus it is more stable in resisting lateral loads.

Chart -3: axial force comparison graph

Axial force is reduced as the forces are taken by the diagonal bracing element and shear wall and make the structure more stable.

Chart -4: base shear comparison graph

Base shear over the model 2 is Heavily Increases and makes the Structure stable against seismic loading.

Chart -5: storey displacement comparison

The displacement in all the storey is tremendously reduced in model 2 in comparison to model 1 which clearly depicts that the model 2 is more stable and efficient in reducing the lateral forces

5. CONCLUSIONS

The Present research shows that the bare frame with coupled shear wall in combination with x bracing provides good result about reducing the stresses and lateral forces over the structure. This implies that these type of structure provide better stability during the seismic activity. Cross bracing system and coupled shear wall bear most of the stresses thus the stresses over the other elements is reduced and they have better margin of strength is left to counteract the future stresses to develop over the structure as a result of seismic activity. The conventional frame edifice gravity load as well as the lateral load is totally bear by the vertical columns and the horizontal beams thus they have very less margin of safety left for resisting any additional force to counteract. For resisting the sudden lateral forces greater section sizes is required which makes the structure uneconomical. The research concluded different points as given below.

- Relative comparison shows that bending moment, shear force, axial force are reduces in our model , thus it shows stability against sudden stresses in model 2 with same section sizes in both the structure.
- Relative study also concluded that as the stresses is properly distributed over the structure the lateral displacement is also get reduces.

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