Comparitive Analysis of RCC Building With And With Out Outriggers And Diagrid System

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Abstract- *The innovation of high strength structural materials and the introduction of dominant development methods gave a lift in the development of tall structures. As the height of the structure increases, they become more and more vulnerable to wind load and seismic load. The opposition of tall structures to lateral loads is the principal determinant in the formulation of new basic structural frameworks that develop by the constant efforts of structural engineers to keep on increasing the building height while keeping the deflection withn permissible points of confinement and limiting the measure of materials. In this proposed work an analytical study will be consider on such systems like outrigger system with core shear wall and diagrid systems, transferring the lateral loads safely to the ground which determines their structural efficiency. A comparison of outrigger system with core shear wall and a diagrid system will be made on a 11-story building reinforced concrete building by using standard package ETABS 2019 by comparing different parameters such as Maximum Story Displacement, Maximum Story Drift, Storey Shear,moment ,joint displacement .joint reactions and base reactions.*

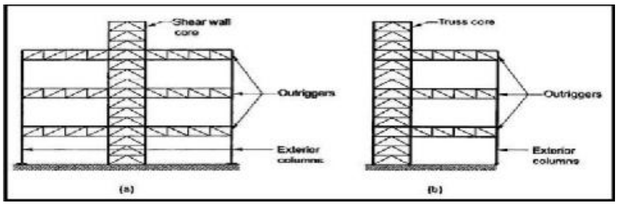
Keywords- Structural Analysis, forces, deflection, lateral forces, Etabs

I. INTRODUCTION

For designing a tall structure, on increasing the building height, the problems also increase, and the building's dead load, live load acting, earthquake loads, and other forces are changing. We must guarantee a safe working environment for multi-storey buildings against changing actions. When an earthquake occurs, the ground motion generated by the earthquake causes structures to shift vertically and horizontally. A structure must be built to withstand the lateral forces that it will encounter. A structure must be built to bear the forces(lateral) that it will come across. In order to do this, constructions such as moment resistant frames, infilled frames, shear walls, and framed tube need be equipped with lateral resisting systems in the buildings.

1.1 OUTTRIGERS

The outrigger Plays vital role in lateral load stiffness. Columns(externally) are connected to the central core (shear wall) wall with outriggers. Outriggers elements are rigid components that are attached to the structure's core(Externally). When a central core portion tries to bend in the structure, outriggers generate a tension-compression couple in perimeter columns, creating a restraining moment acting on the internal core at the outrigger, which improves the stiffness against overturning.



II. ANALYSIS: STATIC AND DYNAMIC

It is an applied approach to figure out earthquake response of a particular structures using waves and vibration formed during the earthquake. The ideology of the response spectrum(RS) was applicable in designing data need in building codes for seismic or dynamic calculations of various structures. This method involves rigorous calculation of maximum displacements and forces in member using smooth design spectra.

In ETABS, Response Spectrum Analysis (RSM) is done as follows:

1. Base model preparation followed by, seismic loading condition as per IS 1893-2002 by giving the required data input of soil type, Z (zone factor), R factor.
2. In Model Load case loads are defined like Earthquake load, Dead load, Live load and various load combinations were created along with directional specification.

III. LITERATURE REVIEW

1. DESIGN ANALYSIS OF OUTRIGGER AND HEXAGRID SYSTEM IN HIGH RISE BUILDINGS: A REVIEW 2020, Deepak Kumar Ahirwar, K. Divya, Lokesh Singh

The ability of tall structures to withstand horizontal loads is a key element in the development of new structural element frameworks. This is driven by structural engineers' constant struggle to increase building height while keeping deflections within acceptable limits and limiting the amount of material used. An analytical research will be conducted on systems such as outrigger systems with core shear walls and hex grid systems in order to assess their structural effectiveness in safely transmitting lateral stresses to the ground and so keeping the structure stable. We provide a survey of publications pertaining to high-rise structure analysis in this work. Both the diagrid and hexagrid framework guaranteed a successful shear conveyance than a regular framework.

2. Dynamic Analysis of Diagrid Structural System for R.C. Building Structure 2019, SawanRathore, 2. Prof.SumitPahwa

The resistance to horizontal(lateral) loads such as earthquakes(seismic) and wind is currently a key concern in tall building development. Tall structures are prone to laterally displacement when exposed to lateral loading; to protect structure from this lateral load, specific arrangements are made in ordinary framed R.C. buildings, referred to as structural form. In a diagrid construction, vertical columns bending do not resist lateral force but the axial action of diagonals is able to do so. These studies are done for structures for model at various angles of elements connected diagonals, both static analysis and dynamic (response spectrum[RS] and time history) in G+12 storey and G+18 storey building. The static evaluation ETABS software is used to do response spectrum analysis and time history analysis in various parameters like displacement of storey, base shear, storey drift, and time period. The findings of a comparative examination of models of different angled diagrid buildings are then given.

3. SEISMIC BEHAVIOUR OF HEXAGRID TYPE STRUCTURAL SYSTEM, 2019, Safiya Daliya Ahammed, Shahla C. P

High-rise structures require a different analysis and design than low-rise buildings because to lateral forces produced by wind and earthquake. In high-rise buildings, lateral load resistance becomes a crucial criterion that must be considered during analysis and design, and the effectiveness of tall structures is determined by an effective lateral loading resisting system. The "Hexagrid" structural system is introduced in this work to improve the efficiency of tube-type structures in tall buildings. The façade of the building is made up of hexagonal grids. In the hexagrid structural system, almost all conventional columns are eliminated.

4. PERFORMANCE OF WOOD STEEL HYBRID MULTISTOREY BUILDINGS, 2018, Maruf kazi, Roshni John

The performance of timber-based wood-steel hybrid multi-storey structures is examined in depth in this research. It looks at the performance of wood steel hybrid multi-storey structures in areas with high seismic hazard indices, taking into account factors including time period, base shear, and system displacement. To anticipate structural reaction, several wood-steel hybrid models are modelled and evaluated using finite element based software SAP2000, which is a more effective and cost-efficient approach of including shear walls in the design. The utilisation of hybrid wood and steel systems combines the steel frame's high strength and ductility with the hybrid structures' high stiffness and light weight.

IV. METHODOLOGY AND ITS CONSIDERATION

The modelling and analysis of a Outrigger diagrid structural model is carried out using Etabs software. the sizes of structural members, geometric parameters and load consideration of both the structural. The dead load (875-1987, part-i), live load (875-1987, part-ii), earth quake (18932002, part-i) and wind load (875-1987, part-iii) and all load combinations are applied to the all models. The characteristics compressive strength of concrete is taken as 25 N/mm2. the yield strength of main reinforcement is taken as 415 N/mm2.

SPECIFICATIONS OF BUILDING’S MODEL

Table: SPECIFICATIONS OF BUILDING'S MODEL

Specifications	Data
Storey Height	3.0 m
Base Storey Height	3.0 m
Number Of Bays along X Direction	6
Number Of Bays along Y-Direction	6
Bay's Length along X-Direction	3.2 m
Bay's Length along Y-Direction	3.2 m
Concrete Grade	25
Density of Reinforced cement concrete	25 kN/m³
Density of Wall Masonry	20 kN/m³
Density of mild steel	76.97 kN/m³
Regular Column dimensions	300 mm x 600 mm
Beam dimensions	300 mm x 450 mm
Live Load	3 kN/m²
Dead Load	1 kN/m²
Super dead Load	6 kN/m²
Soil Conditions	Medium
Damping Ratio	5%
Poisson Ratio	0.2
Response Reduction Factor(R)	5
Importance Factor	1.5
Seismic Zone	Zone4

DEFINE LOAD PATTERNS

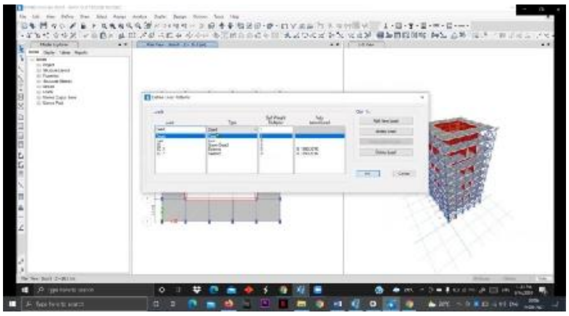


Fig DEFINE LOAD PATTERNS

LOAD COMBINATION

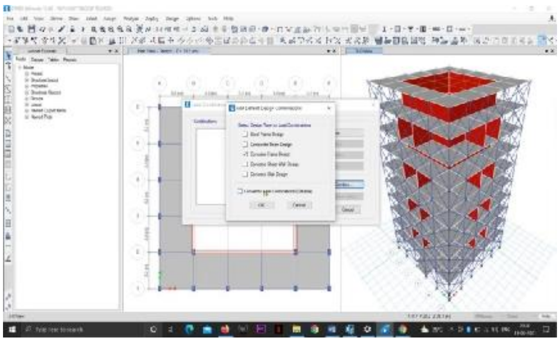


Fig LOAD COMBINATION

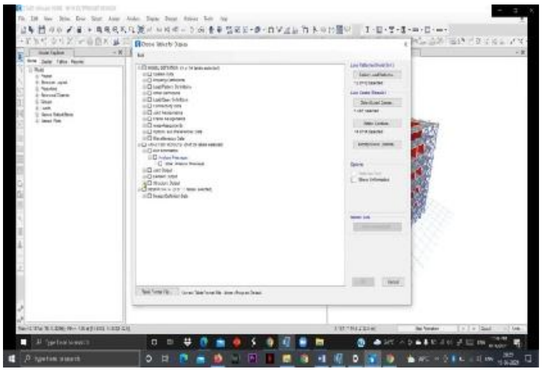


Fig RUN ANALYSIS

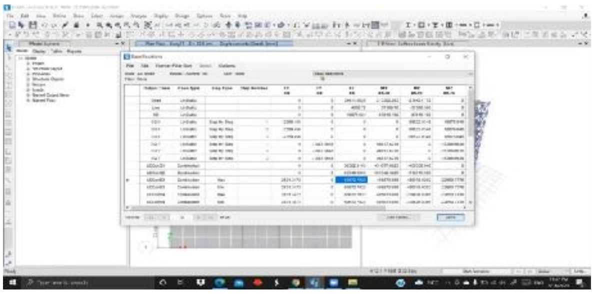


Fig STATIC ANALYSIS of JOINT REACTION

DYNAMIC ANALYSIS BY RESPONSE SPECTRUM ANALYSIS

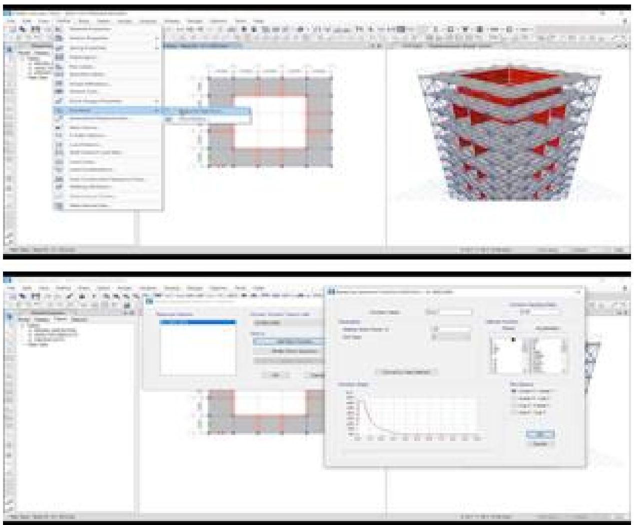


Fig DYNAMIC ANALYSIS BY RESPONSE SPECTRUM ANALYSIS

STORY DRIFT

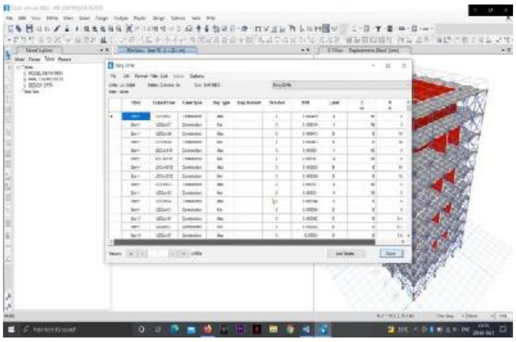


Fig STOREY DRIFT

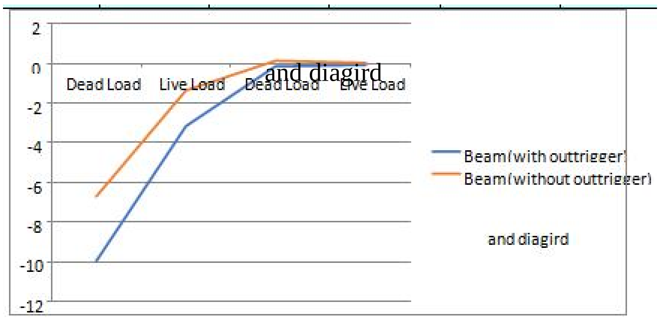
V. RESULT AND DISCUSSION

Fig Storey Drift

In above figure storey Drift for with outrigger is found to be comparatively less than that of without outrigger. It is clearly seen from the result that application of outtrigger and diagrid in a structure reduced the storey drift to a greater extent.

Story	Output Case	Case Type	Step Number	Direction	Drift
Story11	EQ X	LinStatic	1	X	0.000275
Story11	EQ X	LinStatic	2	X	0.000275
Story11	EQ X	LinStatic	3	X	0.000275
Story11	EQ Y	LinStatic	1	Y	0.000258
Story11	EQ Y	LinStatic	2	Y	0.000258
Story11	EQ Y	LinStatic	3	Y	0.000258

Story	Output Case	Case Type	Step Number	Direction	Drift
Story11	EQ X	LinStatic	1	X	0.000132
Story11	EQ X	LinStatic	2	X	0.000132
Story11	EQ X	LinStatic	3	X	0.000132
Story11	EQ Y	LinStatic	1	Y	0.000105
Story11	EQ Y	LinStatic	2	Y	0.000105
Story11	EQ Y	LinStatic	3	Y	0.000105
Story11	RSX	LinRespSpec		X	1.71E-08
Story11	RSY	LinRespSpec		Y	1.69E-08



Graph showing variation of Shear with outrigger and without outrigger

The graph shown above clearly states that the Load combinations (DL, LL, SD) effects are comparatively high for beams with outtrigger and diagrid than that of without outtrigger and diagrid.

VI. CONCLUSION

After the analysis following points can be concluded

- Storey Drift for with outrigger is found to be comparatively less than that of without outrigger.

- Load combinations (DL, LL, SD) effects are comparatively high for beams with outrigger and diagrid than that of without outrigger and diagrid.
- The storey drift is maximum at 11th storey is 0.000132 with application of outrigger and diagrid.
- The storey drift is maximum at 11th storey is 0.000275 without application of outrigger and diagrid.

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