A Seismic Analysis of Steel Diagrid Building And Its Comparision With Conventional Building

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Abstract- *The construction of tall structures continuously increasing throughout the world. Advance in construction technology , material ,structural system and analysis and design facilitate the growth of tall structure.*

Recently diagrid building is emerge as structurally efficient and architecturally significant assemblies of tall structure.

With the use of inclined column on the facade in diagrid building structure which is connected to each other at a node responsible for carrying lateral loads as well as gravity loads .Also diagrid structure provides very good esthetic view .

A regular G+19 storey steel building is analyze with the plan dimension 20m x 20m and the analysis is done by using the ETABS v15 software . all structural members are design with IS 8002007. The load combinations are taken from IS1893(Part 1). The equivalent static method and response spectrum method are taken for the analysis.

In steel diagrid building the diagonal members successfully take the lateral loads which in turn release the axial force in the other member of structure. With the use of diagrid bending moments in the columns are reduces significantly

Keywords- diagrid building, conventional building, diagrid angle.

I. INTRODUCTION

1.1 GENERAL

Tall building construction is increasing day by day therefore the safe analysis and design is should be done for tall building. As the height of the building increasing the lateral load resisting system become very important than structural resisting system that is resisting the gravity loads .therefore the diagrid structure is more economical and suitable for high rise building compare to conventional building.

The term “diagrid” is a combination of two words that is DIAGONAL and GRID refers to a system that is single thickness in nature and gain its structural integrity throughout the use of triangulation .for the triangulation the members like steel tube round, pipe , precast pipes ,and inclined concrete columns are used which connected diagonally to one another forming a complete net which spread the lateral loads equally to the foundation of tall building. The diagrid building helps in avoiding the interior and corner column as the major part of lateral loads as taken by externally provided diagonal member. This intern make the diagrid structure most efficient than conventional structure. the steel use in diagrd structure is 20% less compare to steel use in convention structure.

The famous diagrid tall building made across the world are .the swiss re towerin London, hearst tower in new york, mode gakuen spiral tower in aichi, capital gate in abu dhabi ,west tower in guanzhou , cctv headquarters building in Beijing, cyclone tower in asan,and lotte super tower in Seoul etc.

OBJECTIVE OF THE STUDY

The main objective of the study is to know the seismic performance of diagrid and conventional structure under the zone 4.for the diagrid structure the angle of inclination are taken 62 29’17” and 52 0’5” and a combination of both angles in one model is tried..

The comparison of bending moment and axial force between diagrid and the conventional structure is studied.

The various responses such as storey drift, displacement, bending moment are also studied.

II. LITERATURE REVIEW

2.1 REVIEWS

1. In the year 2005 "MOON" studied the dynamic interrelation b/w architecture & technology in tall structure & providing an initial step toward for diagrid structure .
2. 2. In the year 2007 MOON Et Al studied on the optimum angle for a 60 storey diagrid structure he make two model. Model 1 with vertical column & model 2 with no vertical column in it. Both are taken with different seven diagrid angles & after several calculation shown that the angle b/w 53 & 76 are choice able & the angle 63 is the optimum angle for diagrid system .
3. In the year 2010 KIM & LEE has studied on the performance of diagrid structure with 36 storey at various angle using dynamic & non linear static analysis the result were equated those of diagrid and tubular structure with secondary bracing system .He observed that the slope is enlarge the shear lag effect increase & lateral strength reduced & on the basis of result he concluded that the diagrid angle b/w 60 to 70 is the most effective resisting lateral & gravity loads.

In the year LEONARD investigate on the effect of shear lag in diagrid system & developed on work done of MOON (2005). He concluded that the performance of diagrid structure is three time better than framed tube building in shear lag ration and lateral deflection .and deduced that the high efficiency in taking lateral load in

III. ANALYTICAL MODELING

GENERAL

All models are analyze by using ETABS software. The prepare models are analyze as per using IS codes.

DESCRIPTION OF MODELS

The Seismic analysis of seven different model are consider and are as follows.

MODEL 2: A regular G+19 storey conventional steel frame is considered with the column at periphery.

MODEL 2: A G+19 storey steel diagrid frame is consider with no column at periphery taking the diagid section as steel tube at the with diagrid angle of 62029'17" at periphery.

MODEL 3: A G+19 storey steel diagrid frame is consider with no column at periphery taking the diagrid section as steel tube with diagrid angle of 520 0'17" at periphery.

MODEL 4: A G+19 storey steel diagrid frame is consider with no column at periphery taking the diagrid section as steel tube with a combination of diagrid angle 620 29' 17" & 52o 0'5" at periphery.

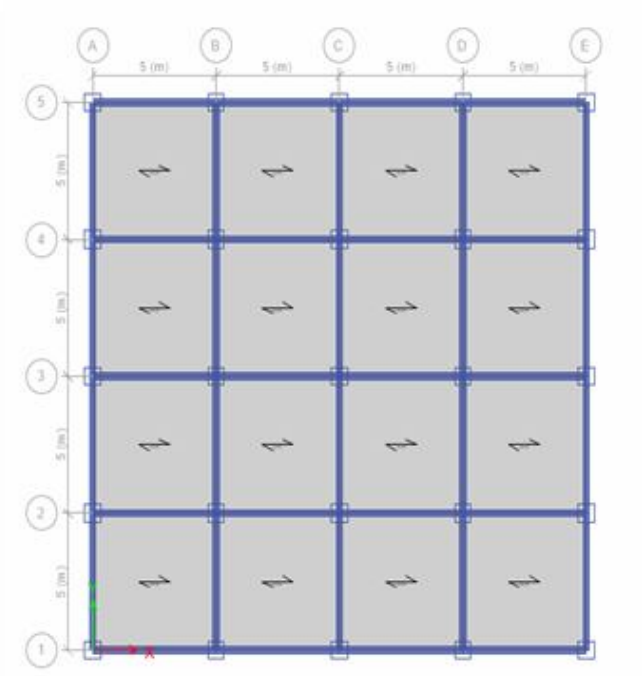
MODEL 5: A G+19 storey steel diagrid frame is consider with no column at periphery taking the diagrid section as pipe with the diagrid angle of 620 29' 17'' at periphery.

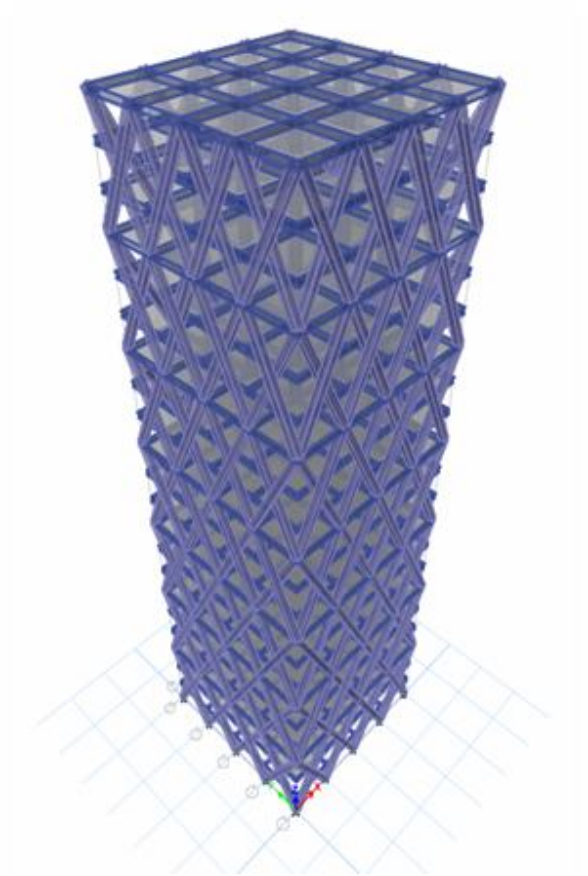
MODEL 6: A G+19 storey steel diagrid frame is consider with no column at periphery taking diagrid section as pipe with the diagrid angle of 520 0' 5''at periphery.

MODEL 7: A G+19 storey steel diagrid frame is consider with no column at periphery taking the diagrid section as pipe with a combination the diagrid angle of 620 29' 17" & 520 0' 17" at periphery.

Structural Parameters

Description	Values
Type of the structure	Steel frame
Number of storey	G+19
Plan Size	20mX20m
Number Of Bays Along X & Y	4
Length Of Each Bay	5m
Storey Height	3.2m
Grade of Concrete	M25
Grade Of Steel	Fe 345
Seismic Data as per IS 1893(part 1):2002	
Seismic Zone 4 **Response Reduction Factor** 5 **Importance Factor** 1.5	
Type of Soil	Medium
Load Calculation	
Dead load 4Kn/Sq.m Dead load on floor 1KN/Sq.m Wall load 11 KN/Sq.m Live load 4KN/Sq.m	
SLAB DETAILS	
Deck slab	125mm
Diagrid Angle	62° 29' 17" 52° 0' 5" 62° 29' 17" & 52° 0' 7"
Diagrid Section	Steel tube
Beam Size	ISWB 550
Column Size	(850X850X20)mm (675X675X20)mm (650X650X10)mm
Diagrid Section	Circular Pipe
	615mm





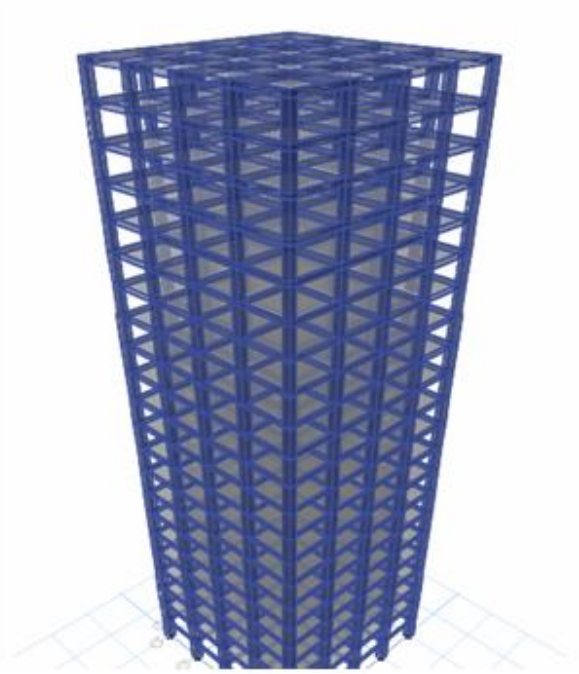


Fig. 3D View of Conventional Structure

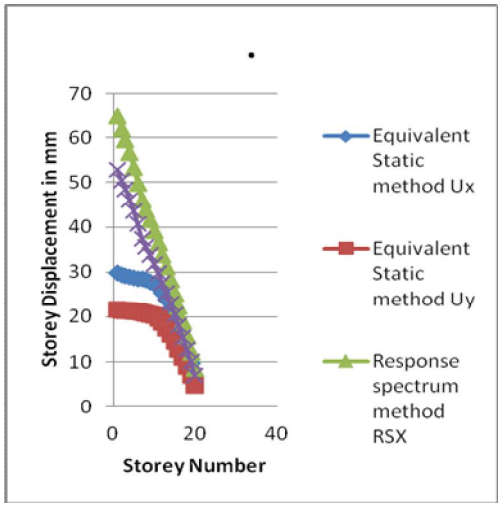
IV. RESULTS AND DISCUSSION

GENERAL

All model are analyzed using ETAB v15 software. The load combination are taken g\from Indian standard. The comparison b/w conventional building frame and six diagrid building frame with three different angles are analyzed and the results are shown for .The storey displacement, storey drift, axial force of different seven mode.

Based on results graphs have been plotted

STOREY DISPLACEMENT



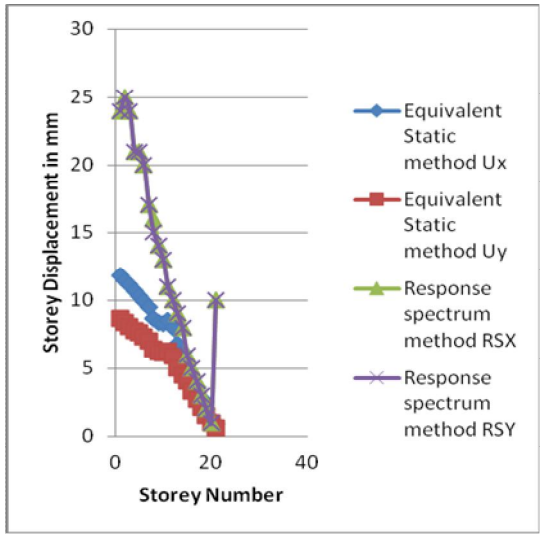
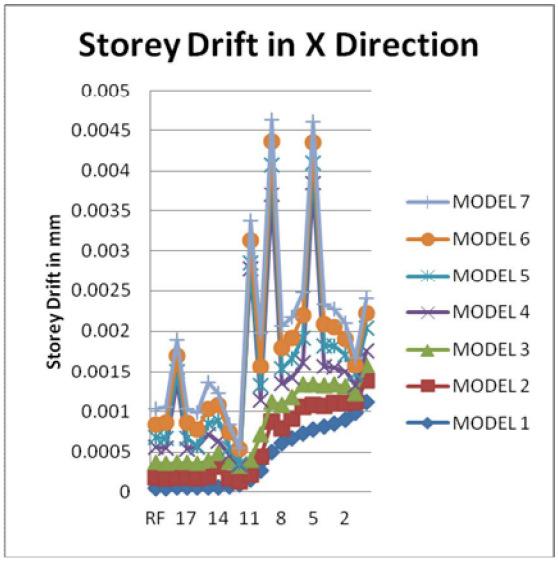
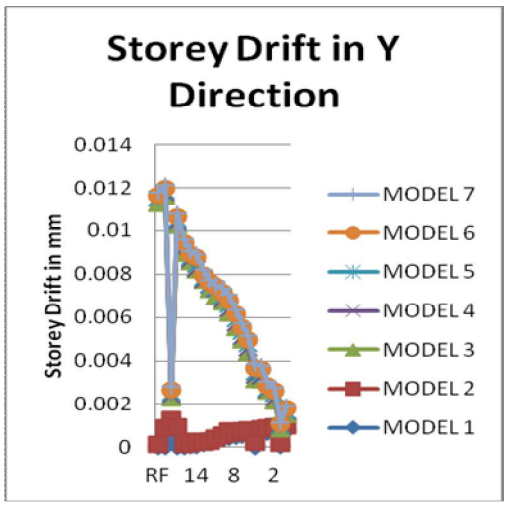
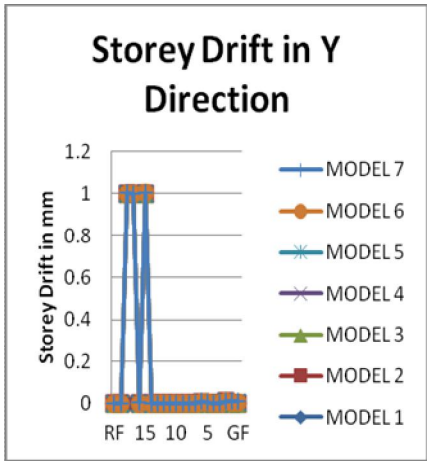
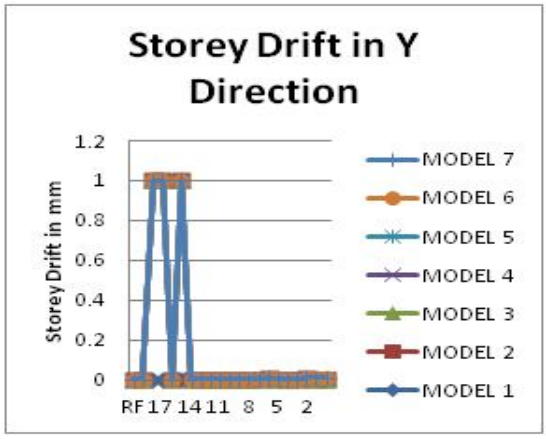


Fig. Storey Displacement of Diagrid Structure

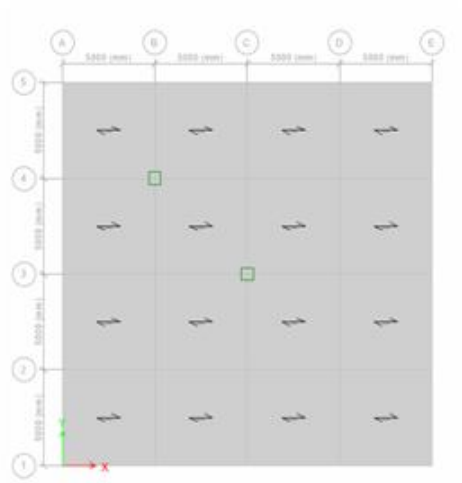


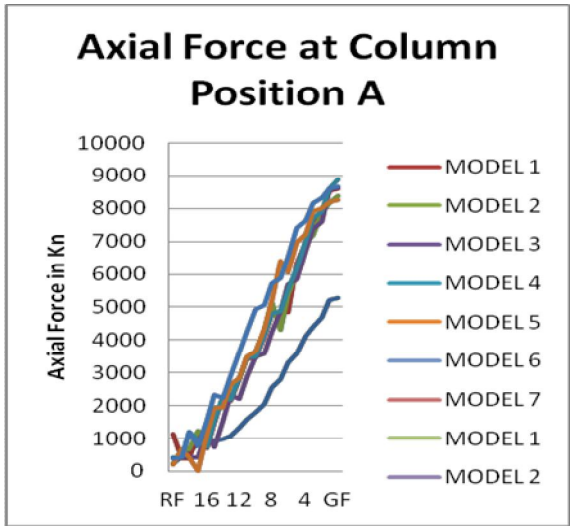


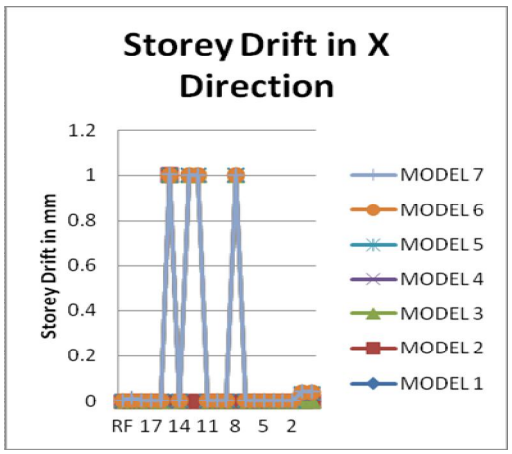


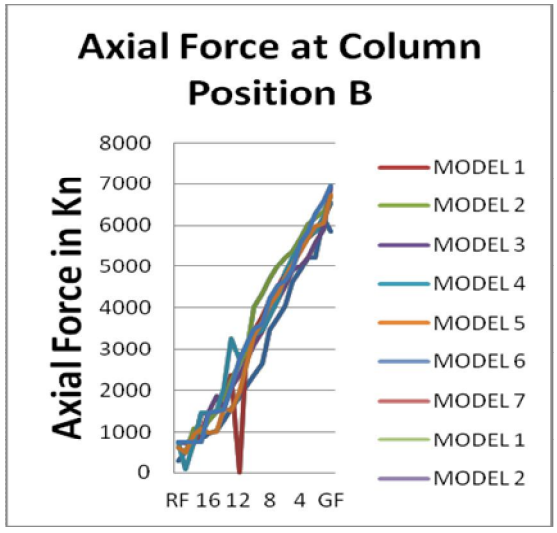


AXIAL FORCE









V. CONCLUSION

- From the study it is observed that the most of the lateral loads resisted by the diagrid member provided at

pheriphery in diagrid frame that makes its better performance when compared with conventional frame.

- Diagrid Structural system is more effective than conventional system.
- The storey displacement in diagrid building is less than conventional building.
- The angle 62o is the optimum angle for the diagrid building which shows better results compared to other angles.
- The storey drift in diagrid building is very much less than conventional building.
- The bending movement in interior column is found decreasing in diagrid building when compared with conventional building.

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