COMPARATIVE STUDY OF CONVENTIONAL, DIAGRID AND CORE WALL STRUCTURES

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Abstract - *In this work comparative study of various structures such as conventional structure, diagrid structure and core wall structure is carried out to analyze the parameter such as displacement, storey drift, time period and base shear for each of the above mentioned structures. E-tab tools are utilized for modeling and analyzing various forms of structures in order to find the required parameters considered in the study. It was found from the study that, the displacement values was found to be maximum for conventional building as compare to diagrid and core wall structures corresponding to 20th storey. It was also found maximum storey drift was found for conventional structure 0.003605m, similarly for diagrid structure and core wall structure it was found to be 0.000961m and 0.000544m respectively. Similar analysis is carried out to determine the base values and time period for conventional structure, diagrid structure and core wall structures.*

***Key Words*: E-TABS, DIAGRIDS, SEISMIC LOADS, E-STATIC ANALYSIS, DISPLACEMENT/STOREY DRIFT/BASE SHEAR/TIME PERIOD.**

1. INTRODUCTION

The early growth of urban population and limitation of accessible land, the taller structures area unit preferred currently each day. So, once the height of structure will increase then the thought of lateral load is extremely a lot of necessary. For the resistance of lateral load system is additional necessary for gravitational loads to resist the structural system. The resisting of the lateral load systems that area unit wide used rigid frame, shear wall, wall frame, tubular system and braced tube system. Recently the diagonal diagrid structural system is more application for tall structure because of its structural strength and aesthetic potential provided by the distinctive geometrical property of the system. Since the structural effective of the diagrid and good aesthetic appearance has generated revived interest from field of study and structure designer for the tall building structures. The main thing of diagrid structures all the exterior columns is eliminated. This is possible because the diagonal members of Diagrid structural systems do gravity loads namely properly as much lateral forces due in conformity with their triangulated configuration, whereas the diagonals of conventional braced frame building elevate only lateral loads.

Reinforced concrete core wall which have more horizontal stiffness and load carrying capacities is more subjected to earthquake. In a tall RC structure with reinforced concrete core wall is designed as a seismic zone area. It is necessary to calculate the structural capacities of the structure, especially provide reinforced concrete core wall subjected to lateral load.

2. BUILDING DESCRIPTION

Table -1: Description of RC framed structure

Description	Model-1	Model-2	Model-3
No. of stories	20	20	20
Total floor height	3.6m	3.6m	3.6m
Dimension of structure	20m x 20m	20m x 20m	20m x 20m

Table -2: Material Properties of Concrete and Steel

Property	**Value**
Grade of steel (N/mm^2)	Fe 500
Grade of concrete for all structural members (N/mm^2)	M30, M40
Modulus of elasticity of concrete (kN/m^2)	$E_c = 5000\sqrt{fck}$ $= 5000\sqrt{30}$ $= 27387$
Poisson's ratio for concrete	0.2
Concrete density	25 kN/m^3

Table -3: Geometric Parameters

Parameter	Value
Plan	20mx20m
Beam	0.375m x 0.6m
Column	0.75m x 0.75m
Diagrids	.375mx.8m
Building type	Commercial
Slab thickness	0.15m
Diagrids angle	63^0
Height of each storey	3.6m
Grade of concrete for beam	M30
Grade of concrete for Column	M40
Grade of concrete for Slab	M30

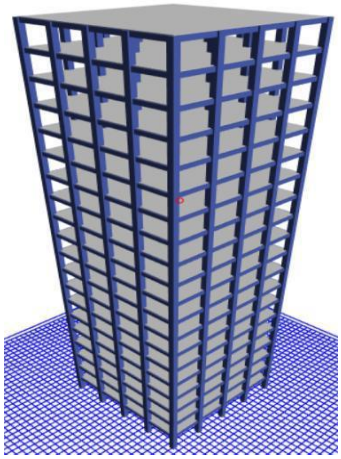

Fig -1: 3D view of conventional structure

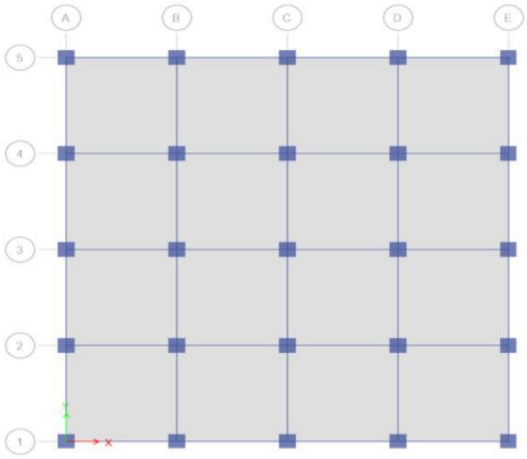

Fig – 2: Plan view of conventional structure

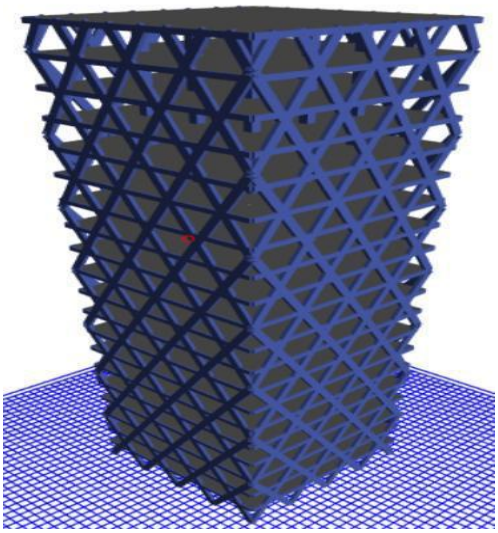

Fig – 3: 3D view of diagrid structure

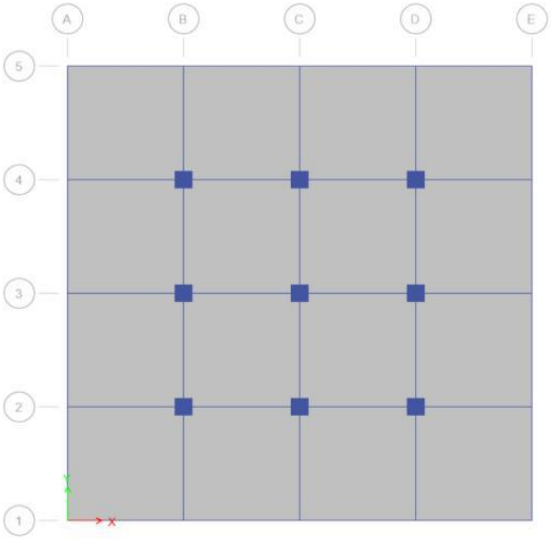

Fig -4: Plan view of diagrid structure

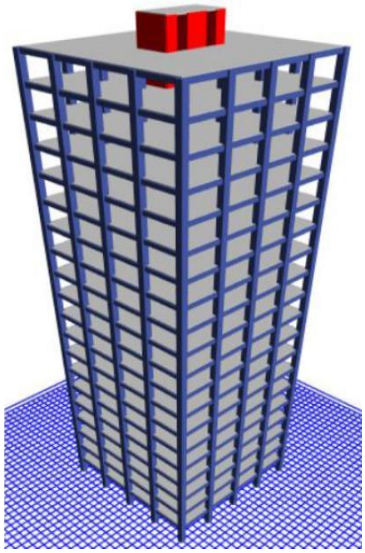

Fig -5: 3D view of core wall structure

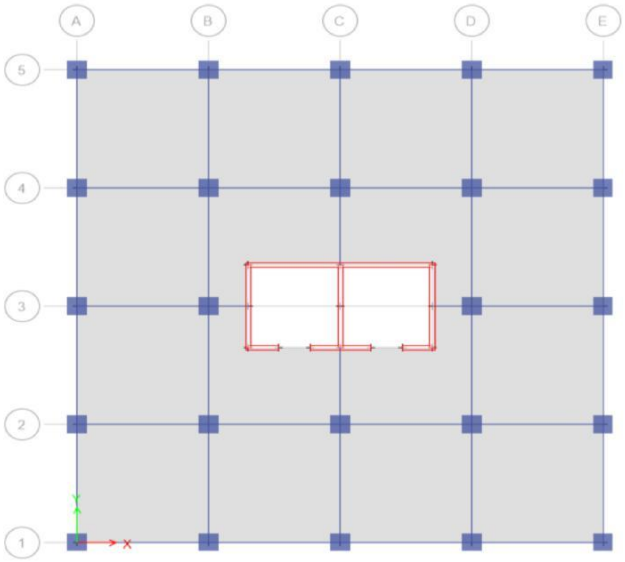

Fig -6: Plan view of core wall structure

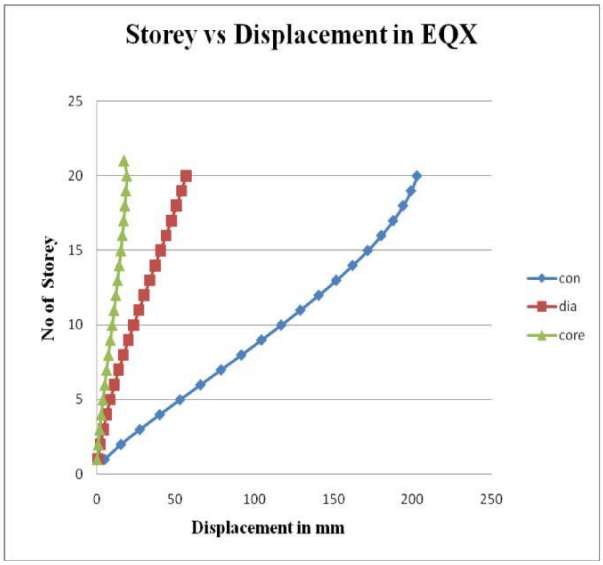

Fig -7: Graph shows displacement in EQX

3. RESULTS AND DISCUSSIONS

Equivalent static analysis is carried out for multi-storey building in both EQX and EQZ direction respectively and displacement, storey drift, time period and base shear were found out for conventional, diagrid and core wall structures the results of the same are listed in the following figures and tables.

3.1 DISPLACEMENT VALUES FOR DIFFERENT MODELS IN EQX

Storey	Load cases	Displacement in EQX (mm)		
		Conventional structure	Diagrid structure	Corewall structure
Storey21	EQX			28.665
Storey20	EQX	202.927	56.745	31.639
Storey19	EQX	199.107	53.693	30.691
Storey18	EQX	194.11	50.547	29.575
Storey17	EQX	187.825	47.299	28.311
Storey16	EQX	180.323	43.931	26.908
Storey15	EQX	171.726	40.508	25.379
Storey14	EQX	162.17	37.098	23.736
Storey13	EQX	151.789	33.615	21.997
Storey12	EQX	140.71	30.147	20.178
Storey11	EQX	129.055	26.81	18.297
Storey10	EQX	116.939	23.395	16.372
Storey9	EQX	104.466	20.143	14.421
Storey8	EQX	91.737	17.047	12.462
Storey7	EQX	78.841	13.944	10.513
Storey6	EQX	65.865	11.222	8.593
Storey5	EQX	52.892	8.597	6.724
Storey4	EQX	40.021	6.126	4.935
Storey3	EQX	27.416	4.245	3.264
Storey2	EQX	15.455	2.328	1.77
Storey1	EQX	5.223	0.701	0.573

3.2 DISPLACEMENT VALUES FOR DIFFERENT MODELS IN EQY

Storey	Load cases	Displacement in EQY (mm)		
		Conventional structure	Diagrid structure	Corewall structure
Storey21	EQY			29.337
Storey20	EQY	202.927	57.316	28.371
Storey19	EQY	199.107	54.192	27.442
Storey18	EQY	194.11	50.992	26.409
Storey17	EQY	187.825	47.668	25.271
Storey16	EQY	180.323	44.201	24.022
Storey15	EQY	171.726	40.687	22.658
Storey14	EQY	162.17	37.202	21.187
Storey13	EQY	151.789	33.662	19.617
Storey12	EQY	140.71	30.153	17.964
Storey11	EQY	129.055	26.792	16.241
Storey10	EQY	116.939	23.382	14.466
Storey9	EQY	104.466	20.138	12.658
Storey8	EQY	91.737	17.044	10.838
Storey7	EQY	78.841	13.941	9.027
Storey6	EQY	65.865	11.22	7.254
Storey5	EQY	52.892	8.596	5.549
Storey4	EQY	40.021	6.125	3.953
Storey3	EQY	27.416	4.245	2.519
Storey2	EQY	15.455	2.328	1.313
Storey1	EQY	5.223	0.701	0.416

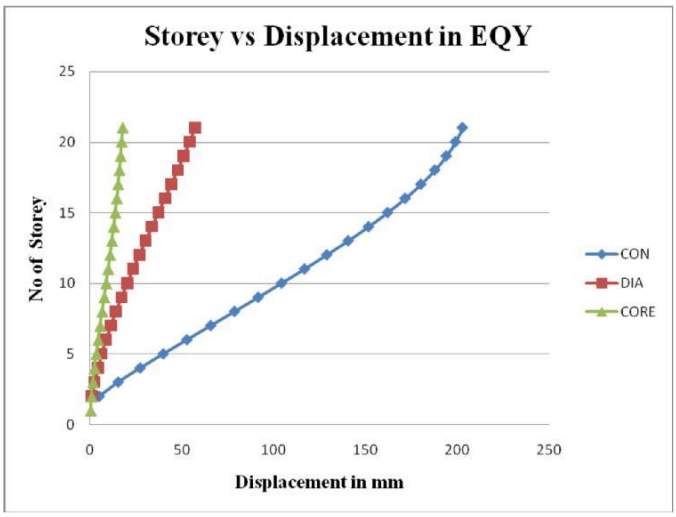

Fig -8: Graph shows displacement in EQY

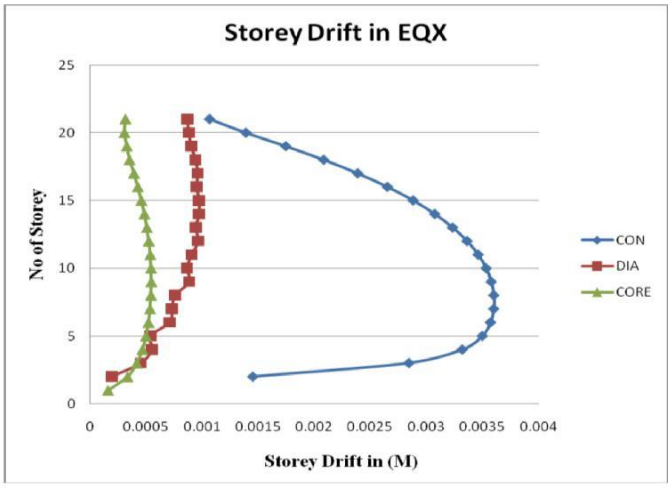

Fig -9: Graph shows storey drift in EQX

3.3 STOREY DRIFT VALUES FOR DIFFERENT MODELS IN EQX

Storey	Load cases	Storey drift in EQX (m)		
		Conventional Structure	Diagrid structure	Corewall structure
Storey21	EQX			0.000314
Storey20	EQX	0.001064	0.000865	0.000305
Storey19	EQX	0.001389	0.000878	0.000327
Storey18	EQX	0.001746	0.000902	0.000351
Storey17	EQX	0.002084	0.000937	0.00039
Storey16	EQX	0.002388	0.000958	0.000425
Storey15	EQX	0.002654	0.000947	0.000456
Storey14	EQX	0.002884	0.00097	0.000483
Storey13	EQX	0.003077	0.00097	0.000505
Storey12	EQX	0.003237	0.000941	0.000522
Storey11	EQX	0.003366	0.000961	0.000535
Storey10	EQX	0.003465	0.000904	0.000542
Storey9	EQX	0.003536	0.000862	0.000544
Storey8	EQX	0.003582	0.000883	0.000541
Storey7	EQX	0.003605	0.000756	0.000533
Storey6	EQX	0.003604	0.00073	0.000519
Storey5	EQX	0.003575	0.000707	0.000497
Storey4	EQX	0.003502	0.000538	0.000465
Storey3	EQX	0.003323	0.00055	0.000415
Storey2	EQX	0.002846	0.000452	0.000332
Storey1	EQX	0.001451	0.000195	0.000159

3.4 STOREY DRIFT VALUES FOR DIFFERENT MODELS IN EQY

Storey	Load cases	Storey drift in EQY (m)		
		Conventional structure	Diagrid structure	Corewall structure
Storey21	EQY			0.00027
Storey20	EQY	0.001064	0.000885	0.000262
Storey19	EQY	0.001389	0.000899	0.000287
Storey18	EQY	0.001746	0.000924	0.000316
Storey17	EQY	0.002084	0.00097	0.000347
Storey16	EQY	0.002388	0.000984	0.000379
Storey15	EQY	0.002654	0.000969	0.000409
Storey14	EQY	0.002884	0.000989	0.000436
Storey13	EQY	0.003077	0.000986	0.000459
Storey12	EQY	0.003237	0.000951	0.000479
Storey11	EQY	0.003366	0.000961	0.000493
Storey10	EQY	0.003465	0.000903	0.000502
Storey9	EQY	0.003536	0.000862	0.000506
Storey8	EQY	0.003582	0.000883	0.000503
Storey7	EQY	0.003605	0.000756	0.000493
Storey6	EQY	0.003604	0.00073	0.000474
Storey5	EQY	0.003575	0.000708	0.000444
Storey4	EQY	0.003502	0.000539	0.0004
Storey3	EQY	0.003323	0.000551	0.000336
Storey2	EQY	0.002846	0.000452	0.000249
Storey1	EQY	0.001451	0.000195	0.000116

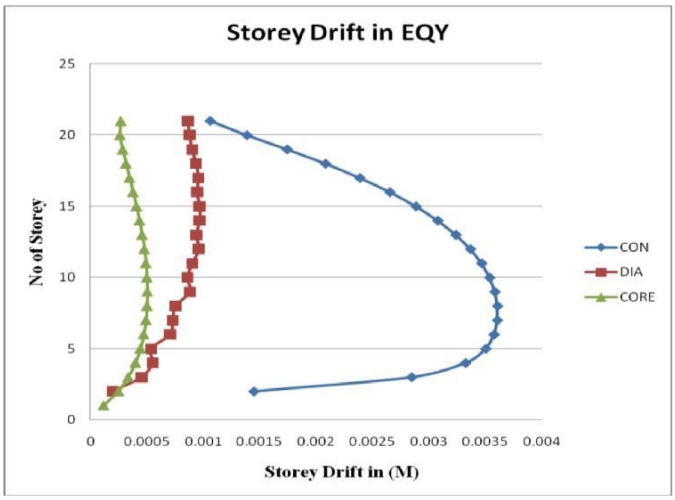

Fig -10: Graph shows storey drift in EQY

3.5 TIME PERIOD VALUES FOR DIFFERENT MODELS

Modes	Conventional Time period in (sec)	Diagrid Time period (sec)	Corewall Time period (sec)
1	2.897	1.394	2.481
2	2.897	1.391	2.42
3	2.471	0.499	1.952
4	0.939	0.377	0.801
5	0.939	0.373	0.717
6	0.811	0.195	0.555
7	0.53	0.192	0.456
8	0.53	0.17	0.362
9	0.472	0.138	0.307
10	0.362	0.136	0.278
11	0.362	0.111	0.224
12	0.324	0.108	0.224
13	0.267	0.105	0.183
14	0.267	0.096	0.172
15	0.241	0.094	0.155
16	0.207	0.085	0.137
17	0.207	0.083	0.137
18	0.187	0.078	0.116
19	0.165	0.078	0.113
20	0.165	0.077	0.11
21			0.094

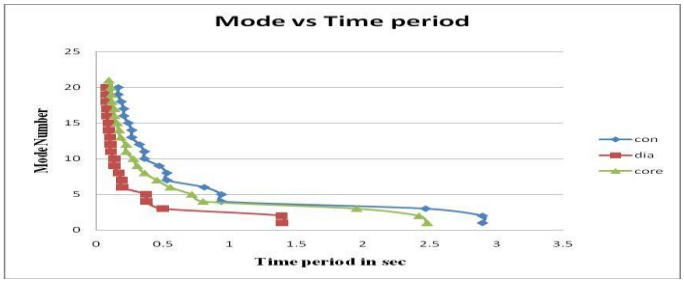

Fig -11: Graph shows time period

3.6 BASE SHEAR VALUES FOR DIFFERENT MODELS IN EQX

BASE SHEAR IN EQX DIRECTION			
Structural form	Conventional Structure(KN)	Diagrid Structure(KN)	Core wall Structure (KN)
BASE SHEAR	6944.5091	7178.5621	1615.941

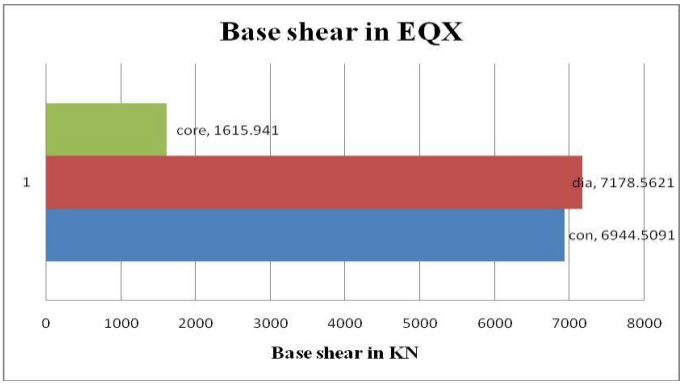

Fig -12: Graph shows base shear in EQX

3.7 BASE SHEAR VALUES FOR DIFFERENT MODELS IN EQY

BASE SHEAR IN EQY DIRECTION			
Structural form	Conventional Structure(KN)	Diagrid Structure(KN)	Core wall Structure(KN)
BASE SHEAR	6944.5091	7178.562	1303.62

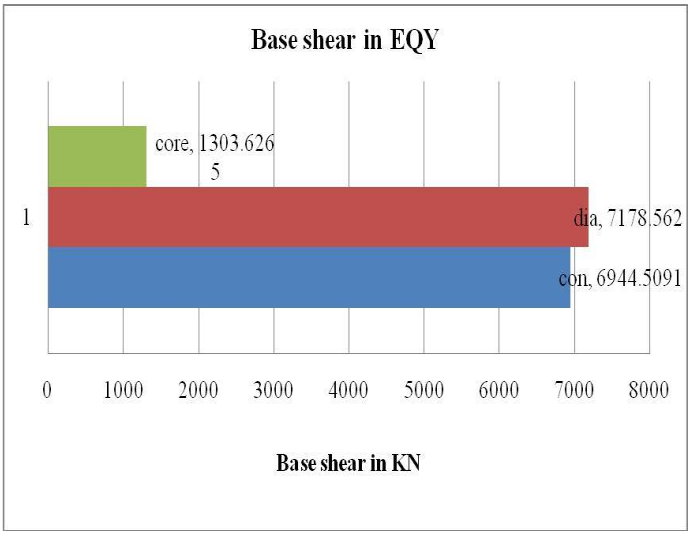

Fig -13: Graph shows base shear in EQY

CONCLUSIONS

In the present study comparison is made between different form of structures for instance conventional, diagrid and core wall structure by analysing and comparing the parameters such as storey drift, displacement, Time period and Base shear. An arrangement of 20m X 20m is considered, with different structural forms and the relative study is carried out and the following conclusions are drawn which are as follows,

- The displacement value obtained from analysis corresponding to 20_{th} storey for core wall structure showed a 31.639 mm displacement which was less compare to conventional and diagrid structure of displacement values of 202.927 mm and 56.745 mm respectively.
- The maximum storey drift for conventional building corresponding to storey 7 was found to be 0.0036m, similarly for diagrid and core wall structure, the storey drift corresponding to storey 11 and storey 9 was found to be 0.000961m and 0.00054m respectively.
- It was found that the time period constantly decreases with increase in mode, the maximum value of time period for conventional, diagrid and core wall structure was found to be 2.897, 1.394 and 2.481Sec respectively for least value of mode.
- The maximum value of base shear was found for diagrid structure which was 7178.562KN compare to conventional and core wall base shear values of 6944.504KN and 1615.941KN respectively.

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