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A Study Of Lateral Drift Controlling Between Two Buildings By Connecting Sky Bridge

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***Abstract*: The Objective of this study is to control drift and displacement by providing sky bridge between two high rise buildings and to ensure fire safety to the people during fire effects Here two 20 storey buildings, 10m apart are analyzed individually to find where the drift and displacements are maximum for that maximum drift value skybridge is connected and analyzed again to check weather drift and displacements are minimized in the structure. Loads are applied as per code and Analysis is performed using E-TABS 2015 software**.

Keywords: **Irregular building, Drift; Displacemen, Skybridge, E-TABS analysis of structure.**

1. INTRODUCTION

By definition, a bridge is a structure built to a cross valley, street, water way or any other physical impediment. It allows individuals travelling or goods being transported easier means of access by providing a more uniform and more effortlessly negotiable route. Similarly, a sky bridge or sometimes referred to as sky ways fill the same needs yet to build off the ground. In short, the sky bridge gives linkage and entry between one building to other. Sky Bridge can be different structure and designs serve various functions. It can be pedestrian crossing, a penthouse, etc.

A structural point of view the proposed sky bridge provides a means of lateral resistance to the building towers. This is due to fact that the sky bridge functions like a horizontal diaphragm like floor slab. Note that the floor system made of slab act as horizontal diaphragm with very large stiffness in the horizontal direction. They help to convey the lateral load into vertical structural elements such as ramparts and columns separated from opposing vertical load. For investigation we considered 3 models named as towerA, tower B and tower AandB of 20 stories each and storey height is 3m. Here tower A and tower B are 10 meters apart are analyzed individually to find where the drift is maximum for that drift value sky bridge is connected and analyzed again to check whether drift and displacements are minimized or not. Here we provided two sky bridges at 8^{th} floor and 18^{th} floor the reason behind this during any fire assault and blast the people can easily escape using Sky Bridge. We are doing just analysis no designs. Analysis is performed using E-TABS 2015 software for earthquake zone II. It is a shear wall with plate slab type of structure, slabs are assumed as thin plate slabs with 200mm thickness and shear wall is 250mm thick. No beams are provided slabs are directly rest on shear wall.

2. MOTIVATIONS TO DO THE PROJECT WORK

In the previous year's more people were died during fire or any blasts in tall structure for instance attack on world trade center in United States of America. This assault killed the lives of 2996 individuals as well as critical harm to ten other expansive encompassing structures. So in the event that we connect Sky Bridge between two elevated structures individuals staying in tall structures are effortlessly escapes from fire, they can easily move to other building utilizing Sky Bridge. Subsequently this is guaranteed the fire life security for the general population staying in elevated structure. Furthermore, Sky bridge act like a strut to control drift and deflection.

3. OBJECTIVE OF PRESENT WORK

- The primary goal is to control the drift and displacement in the high rise buildings by associating the Sky Bridge.
- Easy escape of individuals during fire effects and different blast condition by skybridge.
- To provide guide lines for structural engineers on the serviceability and the economic aspects that could be acquired by utilizing sky Bridge.

3.1 Methodology:

3.1.1 Model data:

Table I. Building Data

structure	OMRF
No of storey	20
Storey height	3.0 M
Grade of concrete(fck)	M20
Grade of steel(fy)	Fe 415
Slab thickness	200mm
Shear wall thickness	250mm
Soil type	I
Importance factor	1
Response reduction factor	3
Dead load	1kn/m^2
Live load	As per code IS 875(part2)
Floor finish	1.5kn/m^2

3.1.2 Model is an irregular plan and it is drafted using AUTO cad:

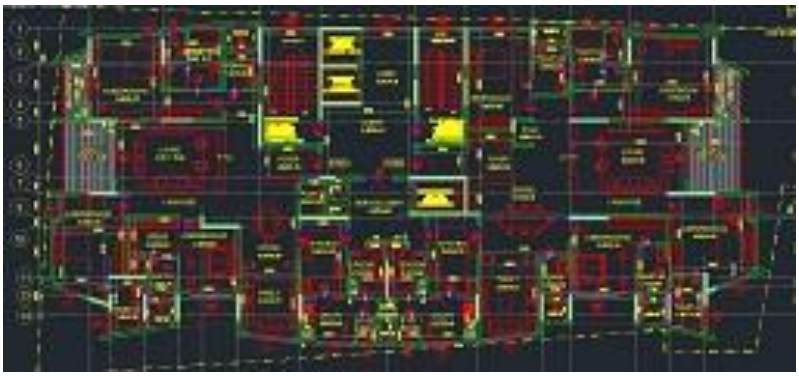


Fig.1: Floor plan

3.1.3 IMPORTING DXF-FILE:

Converting actual plan in to single line diagram using AUTO CAD called “DXF”. To import line diagram in E-TABS, it is necessary to convert drawing file type by saving the same file in dxf extension file type.

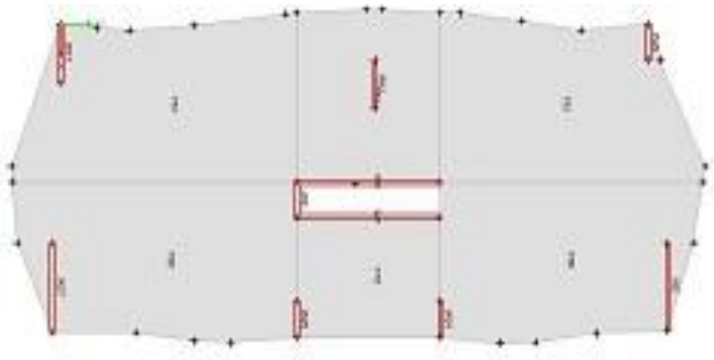


Fig.2: Shear wall with plate slab

3.1.4 ANALYSIS OF STRUCTURE:

ETABS software is used for the analysis of the structure by equivalent static lateral force method for zoneII. And the results are obtained are tabulated for the study of the behavior of the structure.

3.1.5 LOAD CALCULATION

The structure is subjected to the 3 types of primary load as per the provision of IS code of practice

They are

Dead Load (from IS: 875-1987(part 1))

Live Load (from IS: 875-1987(part 2))

Seismic Load (from IS: 1893-2002(part 1))

3.1.6 Load Combinations:

As per IS 1893(part1):2002 clause no.6.3.1.2,

the following load cases have to be cosidered for analysis.

Limit state of collapse

- 1.5(DL+IL)
- 1.2(DL+IL±EL/WL/TL)
- 1.5(DL±EL/WL/TL)
- 0.9(DL±1.5EL/WL/TL)

Limit state of serviceability

- 1(DL+IL)
- 1(DL+WL)
- 1DL+0.8IL+0.8WL

3.1.7 LOADING:

Dead load is taken as 1kN/m^2 and Live load is as per IS: 875-1987(part 2)

3.1.7.1 Seismic loading:

Table.II: Seismic Design Data

Seismic zone	II
Zone factor	0.10
Importance factor	1
Soil type	1
Frame type	OMRF
Response reduction factor	3

For wind loading

V_b= 33 m/s

Terrain category =2

Structure class = Class C

Risk Co-efficient k_1= 1

Topography co-efficient k_3=1

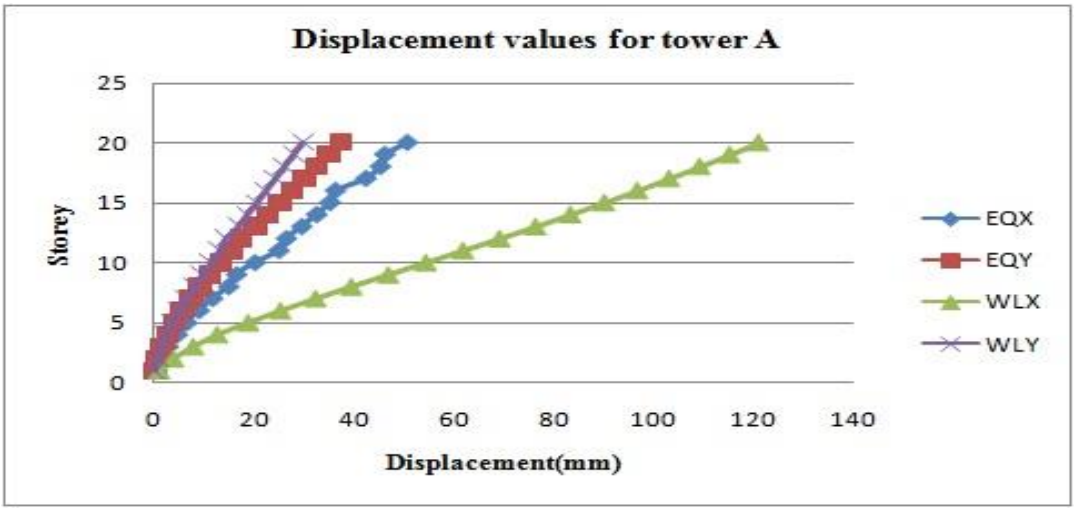
K_2= 1.125 (Terrain category 2, class c & height above 50m)

3.1.8 METHOD OF ANALYSIS:

In this study, analysis of the high rise structure is carried out for lateral loads using Equivalent static force method.

3.1.9 STOREY V/S DRIFT:

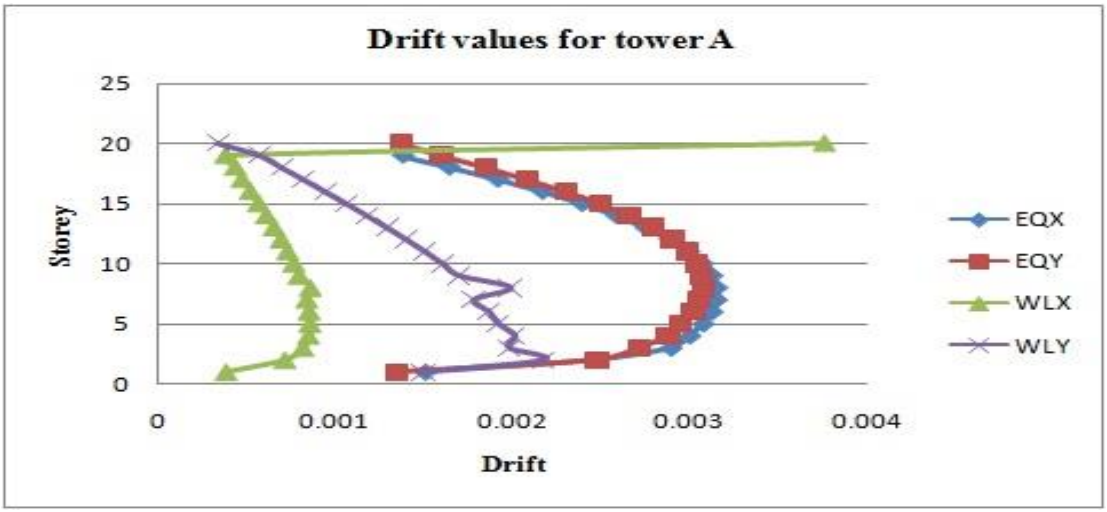
According to clause 7.11.1 of IS 1893-part1:2002 and clause IS 456:2000 the maximum allowable drift is 0.004h and allowable displacement is (H/500) where h is the storey height and H is the total height of the building.



Graph.1: Storey v/s Displacement

Table.III: Maximum storey displacement for Tower A

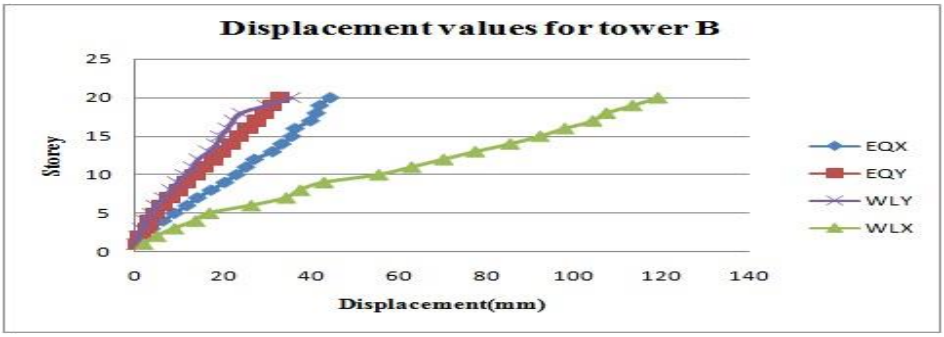
Storey	EQX	EQY	wlx	wly
1	0.4	0.2	1	0.2
2	1.3	0.8	3.8	0.7
3	2.7	1.6	7.8	1.5
4	4.5	2.7	12.6	2.4
5	6.4	4.1	18.8	3.6
6	8.9	5.6	25.3	5
7	11.6	7.4	32.3	6.4
8	14.8	9.2	39.5	8
9	16.4	11.3	46.9	9.6
10	20.1	13.4	54.4	11.4
11	24.9	15.7	61.9	13.1
12	26.4	17.4	69.2	14.3
13	29.5	20.3	76.4	16.8
14	32.5	22.7	83.4	18.6
15	35.2	25.1	90.2	20.5
16	36.3	27.6	96.8	22.3
17	42.4	30	103.2	24.2
18	45.3	32.4	109.3	26
19	46.2	34.8	115.3	27.8
20	50.7	37.2	121.1	29.6



Graph.2: Storey v/s Drift

Table.IV: Maximum storey drift for Tower A

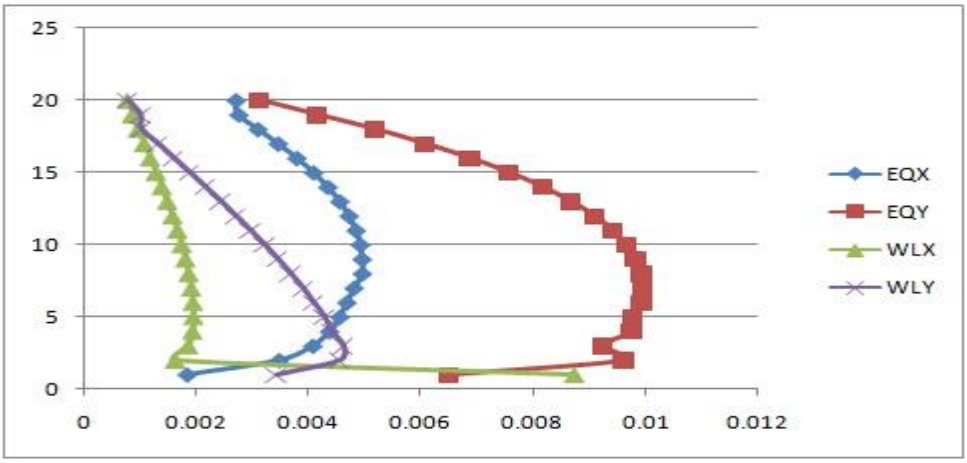
Storey	EQX	EQY	wlx	wly
1	0.001503	0.001343	0.00038	0.001491
2	0.002449	0.002472	0.000711	0.00217
3	0.002888	0.002713	0.000812	0.001975
4	0.002993	0.002872	0.000845	0.002008
5	0.003068	0.002944	0.000852	0.001915
6	0.003118	0.003014	0.000848	0.001862
7	0.003142	0.003049	0.000835	0.001778
8	**0.003143**	**0.003069**	**0.000855**	**0.001985**
9	0.003117	0.003062	0.000791	0.001695
10	0.003065	0.003033	0.000761	0.001601
11	0.002986	0.002977	0.000727	0.001502
12	0.002879	0.002896	0.00069	0.001397
13	0.002743	0.002788	0.00065	0.001288
14	0.002579	0.002652	0.000607	0.001174
15	0.002385	0.002487	0.000562	0.001058
16	0.002162	0.002294	0.000516	0.000939
17	0.001912	0.002073	0.000469	0.000818
18	0.001639	0.001842	0.000432	0.000694
19	0.001376	0.001593	0.000378	0.000571
20	0.001370	0.001368	0.00375	0.000337



Graph.3: Storey v/s Displacement

Table.V: Maximum storey displacement for Tower B

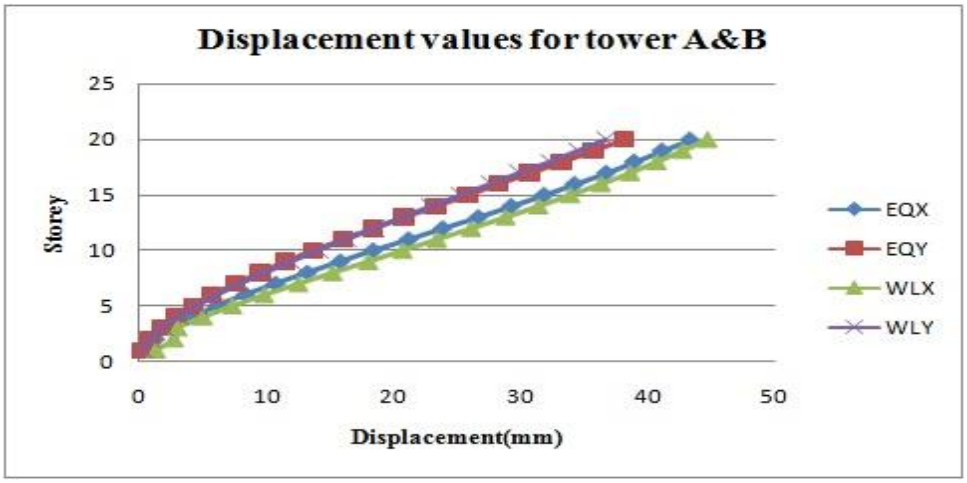
Storey	EQX	EQY	wlx	wly
1	1.2	0.7	1.8	0.2
2	2.1	1.3	4.8	0.7
3	3.8	2.7	8.8	1.5
4	6.4	3.2	13.6	2.4
5	9	4.5	16.8	3.6
6	11.8	6.2	26.3	4.8
7	14.2	7.9	34.3	6.4
8	17.3	9.8	37.5	8
9	20.4	11.7	42.9	9.6
10	23	13.7	55.4	11.4
11	25.2	15.7	62.9	13.1
12	27.1	17.8	70.2	14.3
13	31.2	19.8	77.4	16.8
14	33.3	21.8	85.4	18.6
15	35.6	23.8	92.2	19.5
16	36.3	25.7	97.8	21.1
17	39.8	27.6	104.2	22.3
18	41.1	29.4	107.3	24
19	41.9	31.2	113.3	29.8
20	44.3	32.9	119.1	35.6



Graph.4: Storey/s Drift

Table.VI: Maximum Storey Drift for Tower B

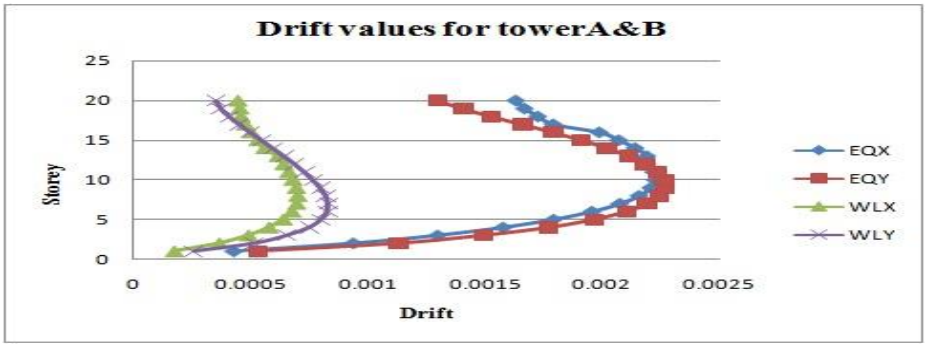
Storey	EQX	EQY	wlx	wly
1	0.001827	0.006498	0.00873	0.003423
2	0.003471	0.009593	0.001632	0.004535
3	0.00407	0.00922	0.001864	0.00461
4	0.004367	0.009744	0.001939	0.004396
5	0.004551	0.009754	0.001957	0.004275
6	0.004675	0.009921	0.001947	0.004081
7	0.004803	0.00993	0.001917	0.003892
8	**0.004952**	**0.009918**	0.001873	0.003675
9	0.004945	0.009817	0.001816	0.003449
10	0.004917	0.009652	0.001748	0.003207
11	0.004838	0.009404	0.00167	0.002956
12	0.004716	0.009077	0.001584	0.002696
13	0.004549	0.008662	0.001492	0.002429
14	0.004338	0.008157	0.001394	0.002155
15	0.004083	0.007556	0.001291	0.001877
16	0.003785	0.006861	0.001185	0.001593
17	0.003451	0.006057	0.001077	0.001312
18	0.003091	0.005168	0.000969	0.001019
19	0.00275	0.004141	0.000867	0.0010
20	0.00270	0.003115	0.000783	0.000774



Graph.5: Storey v/s Displacement

Table.VII: Maximum storey displacement for Tower A&B

Storey	EQX	EQY	wlx	wly
1	0.3	0.2	1.3	0.3
2	1.2	0.8	2.7	0.9
3	2.5	1.7	3	1.8
4	4.2	2.8	5	3.1
5	6.1	4.2	7.3	4.5
6	8.3	5.7	9.8	6.1
7	10.7	7.5	12.5	7.9
8	13.2	9.5	15.2	9.9
9	15.8	11.5	18	11.9
10	18.4	13.7	20.7	14
11	21.2	16	23.4	16.2
12	23.9	18.4	26.1	18.5
13	26.7	20.8	28.8	20.7
14	29.3	23.3	31.4	23
15	31.9	25.8	33.9	25.3
16	34.3	28.2	36.3	27.6
17	36.8	30.7	38.6	29.9
18	39	33.2	40.7	32.3
19	41.2	35.7	42.7	34.5
20	43.4	38.1	44.7	36.7



Graph.6: Storey v/s Drift

Table.VIII: Maximum storey Drift for Tower A&B

Storey	EQX	EQY	wlx	wly
1	0.00043	0.000529	0.000172	0.000254
2	0.00094	0.00113	0.000363	0.000514
3	0.001299	0.001493	0.000487	0.000655
4	0.001578	0.001774	0.000575	0.000751
5	0.001793	0.001965	0.000635	0.000802
6	0.001957	0.002104	0.000672	0.000828
7	0.002076	0.002192	0.000692	0.000831
8	0.002158	0.002247	0.000697	0.000821
9	0.002207	0.002269	0.000691	0.000798
10	0.002227	0.002265	0.000676	0.000767
11	0.00222	0.002235	0.000658	0.00073
12	0.002191	0.002184	0.000638	0.000688
13	0.002191	0.002112	0.000613	0.000642
14	0.00214	0.002021	0.000556	0.000594
15	0.002071	0.001913	0.000527	0.000545
16	0.001988	0.001791	0.000499	0.000497
17	0.001792	0.001661	0.000474	0.00045
18	0.001726	0.001527	0.000454	0.000406
19	0.001669	0.001407	0.000450	0.00037
20	0.001632	0.001297	0.000442	0.000348

4. CONCLUSION

In this work the study is carried out according to earthquake code book IS1893 (part1):2002 and wind code book is IS875 (part1):1987 and analysis is carried out by taking irregular plan of the building (20 storey) on medium (zone-II) and soil (type-II) and also in this work the seismic analysis of irregular plan of the building is done by both static and dynamic methods and wind by static wind analysis method and also in this work we have provided a sky bridge between two structures to check whether it is control the drift and displacement in the structure.

The following conclusion taken in this work

- Our main intention is fire safety so from experiment we can say, if we provide sky bridge at 18th we could save the life of individuals during fire and blasts.
- And we can conclude that the Introduction of Sky Bridge between two towers helps to reduce the lateral displacement, drift and size of sections.
- Aesthetic appearance of the structure is good

5. SCOPE FOR FUTURE WORKS

- Further studies carried out by using column, beam frame structure
- Further studies carried out by increasing number of stories and provide the sky bridge exactly at the center and
- By changing soil parameters and wind parameters

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