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STAGGERED VIERENDEEL COMPARING ANALYSIS BETWEEN SEISMIC AND WIND LOADS

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ABSTRACT

Tall Buildings are affected by lateral loads from seismic & wind loads . the staggered vierendeel frame can sustain Lateral loads efficiently through the action of the entire frame. This system transfers lateral loads to columns as shear and transfer lateral load to foundation through bending. The over turning moment that affect the whole structure is resisted by the tension and compression couple between the columns. This paper presents the study of 54 types of reinforced concrete staggered Vierendeel frame using UBC 97 [6] to analyze the prototype staggered Vierendeel frame. Then, The analysis results used to compare the economy of the prototypes with each other, and study effect of seismic comparing with wind loads . ETABS nonlinear V 9.7 used to analyze each prototype. Then this paper presents the results of analysis that used to assess straining actions of structures.

INTRODUCTION

Seismic & wind forces is a natural lateral force caused by ground motion, and no one can predict its magnitude, date and time. Moreover, no one can reduce or stop those forces, the only thing that can be done is to reduce its effect by adoption of design methodology and selection of appropriate structural statical system to sustain and dissipate energy generated by lateral forces. The selection of statical system shall be done by putting into consideration value engineering, building design target and this can be achieved by using statical system regarding to building type, usage, target coast and its required occupancy level.

There are many systems that can resist lateral load [7], the difference between each system is due to required building behavior, building usage, target value engineering. The most commonly known systems are Frame system, shear wall system, Dual system, Braced Frame system, and staggered truss. Many studies have been done concerning Vierendeel truss system [4], analysis methods [2], seismic behavior of staggered truss [3], and nonlinear analysis [5].Staggered Vierendeel system analysis subjected to seismic force Comparing with wind force is presented in this paper

SCOPE AND OBJECTIVE

The analysis results and prototypes design used as an initial step in confirming the availability of staggered Vierendeel frame in residential multistory market. Staggered Vierendeel frame can be designed with pre-existing procedure, and are capable of offering low floor-to-floor heights. The numerical method can be performed by ETABS can be used to simulate a variety of sequences in order to optimize the stages. Then, staggered Vierendeel frame presented to be competitive with staggered truss systems in terms of material usage, fabrication, and construction.

The main target of analysis is to compare results from each prototype as the following

1. Find drifts for several types of the staggered Vierendeel using UBC for Seismic case of Loading .
2. Find max drift for several types of the staggered Vierendeel using UBC for Wind case of Loading .
3. Comparing the max drift from Seismic case with the max drift from Wind.
4. Study effect of span length of the staggered Vierendeel with drifts.
5. Study effect of floor high of the staggered Vierendeel with drifts.

SUGGESTED METHODOLOGY

ETABS V.9. , based on Finite element analysis, is used to analyze several types of staggered Vierendeel frame “for 25 story building maximum height” to study the drifts in X & Y axies. ETABS V.9.7 is used to analyze each prototype. ETABS is a commercial program and commonly known because of its good interface and its appropriate results in analysis.

INPUT DATA

Analysis models are considering variation in Vierendeel span (L), and Vierendeel height (H) during seismic & wind case of loading for 25-story building. A simplified sketch is displayed in figure (1) for the above parameters.

The analysis models are based on the assumed data, As A 28 N/mm2 for $f^{\backslash}_{c}$ concrete and a 420 Fy N/mm2 Rebar is used in sections. While the applied seismic loads is as per UBC 97 [6], with soil profile SC , Ca = 0.15, Cv = 0.25 , I = 1 and R=5.5.

In addition, the applied wind load is as per ASCE 7-05 [1] with exposure type C, Wind speed 70 mph, and importance factor= 1.The studied cases are based on staged construction and variation in building height, story height, Vierendeel span and length.

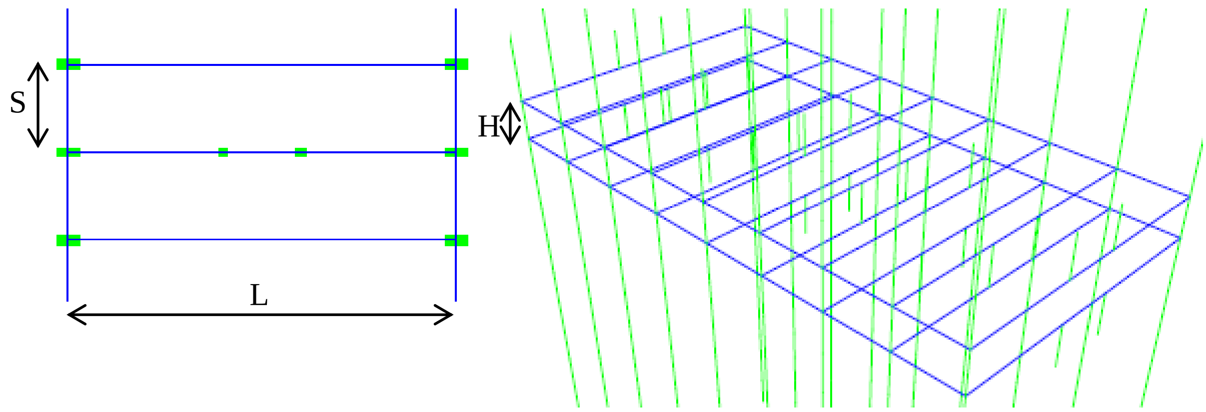


Figure (1): Sketch displaying Vierendeel Module (S), Vierendeel Span (S) and Vierendeel height (H)

Key words: Staggered Vierendeel, ETABS analysis, Staged construction, Drift

DISCUSSING RESULTS

The results of analysis used to assess straining actions of prototypes, compare the economy of the studied prototypes with each other, and study effect of seismic comparing with wind drifts .

Drifts changes with Vierendeel span change and floor high

This study considers drifts for relation between total drift Δx caused by seismic & wind casing of loads. Considering variation in module span and Vierendeel span (L) for different story height (H). While, Tables display a relation between total drift in the two directions during seismic & wind case of loading considering variation in Vierendeel span (L) for different story height (H). Many relations developed from tables.

a) Relation between drifts by wind case of loading to drifts by earthquake case of loading in direction-X by using UBC97 :-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height H =3.0m, 3.5m, 4.0m. Vierendeel Constant span=8m, and module = 6.0m .In wind and earthquakes cases in the direction-x and the ratio between the drifts in the wind to the drifts in earthquakes. The drifts in case of wind increased more than of earthquakes in the direction- x. As show the tables (1-2-3) below.

Table (a-1): Relation between total drift (ΔX mm) of wind and earthquakes at(H=3.0m, S=6.0m, L=8.0m) deferent stories :-

Story	Drift WX(mm)	Drift EX(mm)	Ratio Drift(WX)/Drift(EX)%
STORY25	58.45	101.20	58%
STORY24	57.87	99.83	58%
STORY23	57.17	98.21	58%
STORY22	56.32	96.29	59%
STORY21	55.28	94.04	59%
STORY20	54.0	91.48	59%
STORY19	52.67	88.60	60%
STORY18	51.10	85.47	60%
STORY17	49.33	82.03	60%
STORY16	47.39	78.37	61%
STORY15	45.27	74.43	61%
STORY14	42.98	70.30	61%
STORY13	40.51	65.91	62%
STORY12	37.89	61.34	62%
STORY11	35.08	56.54	62%
STORY10	32.14	51.59	63%
STORY9	29.02	46.41	63%
STORY8	25.77	41.10	63%
STORY7	22.36	35.56	63%
STORY6	18.84	29.91	63%
STORY5	15.18	24.07	63%
STORY4	11.48	18.19	63%
STORY3	7.77	12.30	63%
STORY2	4.28	6.78	63%
STORY1	1.37	2.18	63%

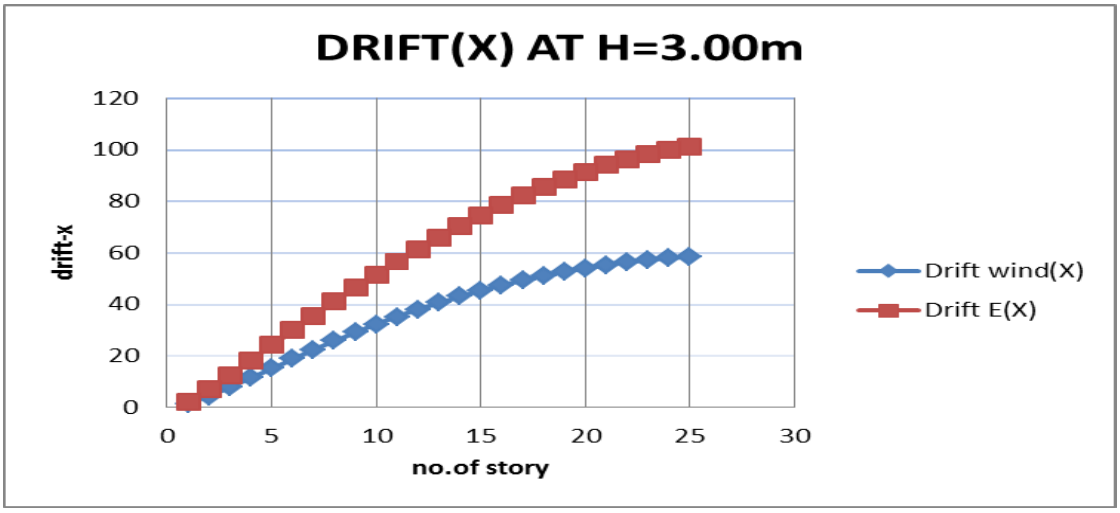


Table (a-2): Relation between total drift (ΔX mm) of wind and earthquakes at (H=3.5m S=6.0m, L=8.0m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio Drift(WX)/Drift(EX)%
STORY25	101.88	121.39	84%
STORY24	100.85	119.72	84%
STORY23	99.61	117.75	85%
STORY22	98.11	115.42	85%
STORY21	96.30	112.68	85%
STORY20	94.17	109.59	86%
STORY19	91.71	106.12	86%
STORY18	88.95	102.33	87%
STORY17	85.85	98.19	87%
STORY16	82.46	93.79	88%
STORY15	78.75	89.06	88%
STORY14	74.77	84.10	89%
STORY13	70.46	78.85	89%
STORY12	65.90	73.39	90%
STORY11	61.02	67.65	90%
STORY10	55.91	61.73	91%
STORY9	50.49	55.54	91%
STORY8	44.87	49.20	91%
STORY7	38.95	42.61	91%
STORY6	32.86	35.89	92%
STORY5	26.53	28.95	92%
STORY4	20.11	21.95	92%
STORY3	13.65	14.92	92%
STORY2	7.56	8.28	91%
STORY1	2.43	2.68	90%

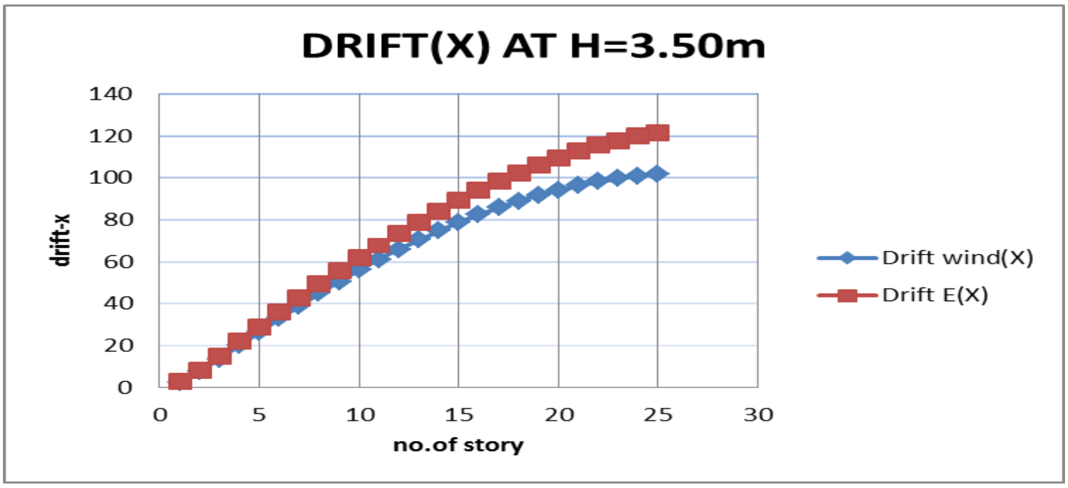
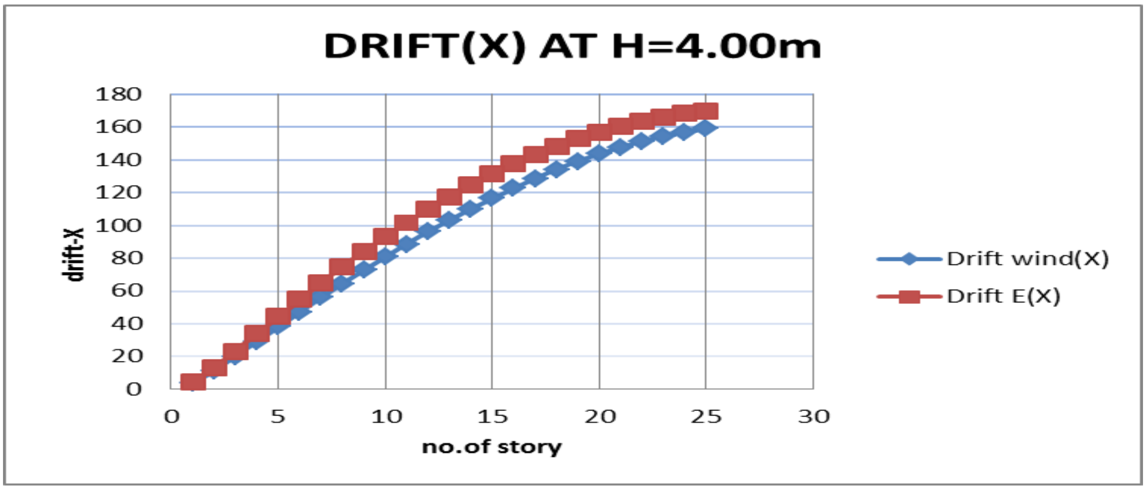


Table (a-3): Relation between total drift (ΔX mm) of wind and earthquakes at (H=4.0m S=6.0m, L=8.0m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio Drift(WX)/Drift(EX)%
STORY25	159.09	169.9	94%
STORY24	156.86	168.13	92%
STORY23	154.24	166.03	93%
STORY22	151.14	163.48	92%
STORY21	147.51	160.41	91%
STORY20	143.42	156.85	90%
STORY19	138.84	152.73	90%
STORY18	133.85	148.11	89%
STORY17	128.41	142.94	89%
STORY16	122.62	137.29	88%
STORY15	116.43	131.1	88%
STORY14	109.94	124.46	88%
STORY13	103.07	117.28	87%
STORY12	95.94	109.7	87%
STORY11	88.44	101.59	87%
STORY10	80.72	93.1	86%
STORY9	72.66	84.1	85%
STORY8	64.39	74.76	86%
STORY7	55.81	64.95	85%
STORY6	47.06	54.85	86%
STORY5	38.03	44.34	85%
STORY4	28.93	33.69	86%
STORY3	19.75	22.93	86%
STORY2	11.03	12.74	84%
STORY1	3.61	4.11	87%



b) Relation between the ratio of total drift of wind in direction-Y to drifts earthquake in direction-Y by using UBC97:-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height(H)=3.0m,3.5m,4.0m. Vierendeel Constant span=8m, and module = 6.0m .In wind and earthquakes cases in the direction-y and the ratio between the drifts in the wind to the drifts in earthquakes. The drifts in case of wind increased more than of earthquakes in the direction- Y. As show the tables (1-2-3) below.

Table (b-1): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.0m S=6.0m, L=8.0m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio Drift(WY)/Drift(EY)%
STORY25	23.03	87.55	26%
STORY24	22.89	86.75	26%
STORY23	22.67	85.62	26%
STORY22	22.39	84.17	27%
STORY21	22.02	82.41	27%
STORY20	21.59	80.37	27%
STORY19	21.08	78.06	27%
STORY18	20.50	75.50	27%
STORY17	19.85	72.71	27%
STORY16	19.13	69.69	27%
STORY15	18.34	66.46	28%
STORY14	17.49	63.02	28%
STORY13	16.56	59.39	28%
STORY12	15.58	55.57	28%
STORY11	14.52	51.58	28%
STORY10	13.41	47.41	28%
STORY9	12.23	43.08	28%
STORY8	10.99	38.59	28%
STORY7	9.70	33.95	29%
STORY6	8.34	29.15	29%
STORY5	6.94	24.19	29%
STORY4	5.48	19.09	29%
STORY3	3.98	13.84	29%
STORY2	2.44	8.48	29%

STORY1	0.94	3.30	29%

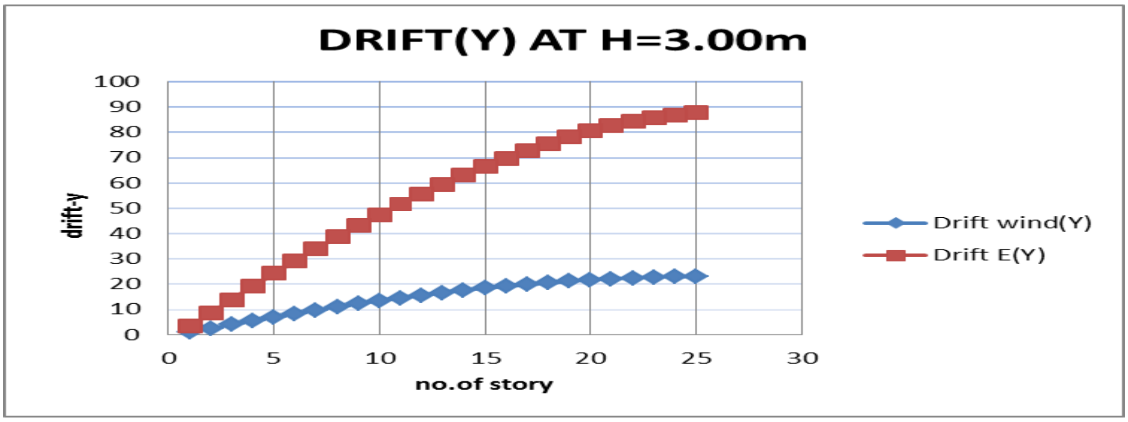


Table (b-2): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.5m S=6.0m, L=8.0m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	39.47	112.40	35%
STORY24	39.20	111.34	35%
STORY23	38.83	109.86	35%
STORY22	38.33	107.96	36%
STORY21	37.71	105.67	36%
STORY20	36.96	103.03	36%
STORY19	36.08	100.051	36%
STORY18	35.09	96.75	36%
STORY17	33.97	93.15	36%
STORY16	32.73	89.26	37%
STORY15	31.37	85.10	37%
STORY14	29.90	80.70	37%
STORY13	28.32	76.04	37%
STORY12	26.63	71.16	37%
STORY11	24.83	66.04	38%
STORY10	22.92	60.71	38%
STORY9	20.90	55.16	38%
STORY8	18.79	49.42	38%
STORY7	16.58	43.49	38%
STORY6	14.28	37.37	38%
STORY5	11.88	31.06	38%
S TORY4	9.40	24.58	38%
STORY3	6.84	17.91	38%
STORY2	4.22	11.08	38%
STORY1	1.66	4.41	38%

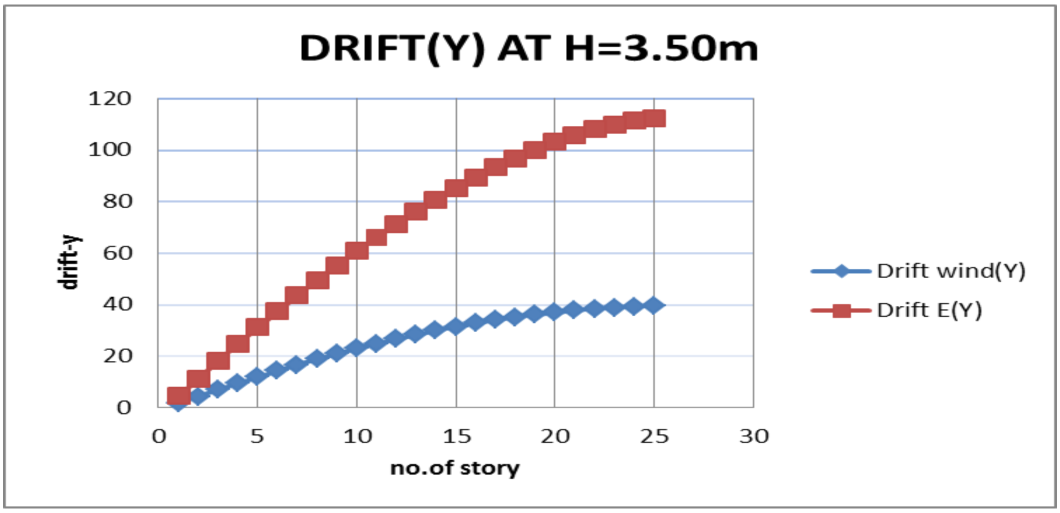
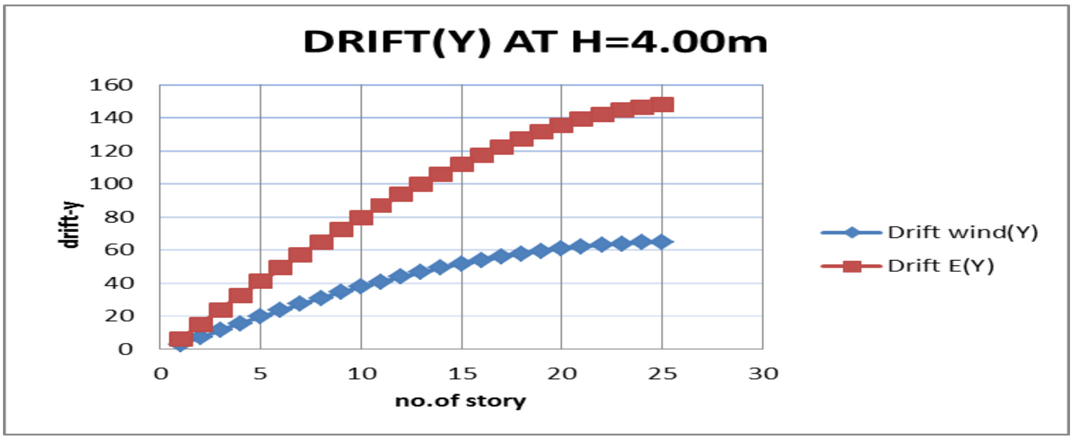


Table (b-3): Relation between total drift (ΔY mm) of wind and earthquakes at (H=4.0m S=6.0m, L=8.0m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	64.94	148.08	44%
STORY24	64.48	146.64	44%
STORY23	63.85	144.65	44%
STORY22	63.01	142.11	44%
STORY21	61.97	139.06	45%
STORY20	60.74	135.55	45%
STORY19	59.29	131.60	45%
STORY18	57.65	127.24	45%
STORY17	55.81	122.48	46%
STORY16	53.77	117.35	46%
STORY15	51.54	111.87	46%
STORY14	49.12	106.06	46%
STORY13	46.52	99.93	47%
STORY12	43.74	93.50	47%
STORY11	40.77	86.77	47%
STORY10	37.64	79.76	47%
STORY9	34.34	72.48	47%
STORY8	30.87	64.95	48%
STORY7	27.25	57.17	48%
STORY6	23.47	49.14	48%
STORY5	19.55	40.88	48%
S TORY4	15.49	32.42	48%
STORY3	11.31	23.72	48%
STORY2	7.02	14.80	47%
STORY1	2.80	6.00	47%



c) Relation between the ratio of total drift of wind in direction-X to drifts earthquake in direction-X by using UBC97:-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height(H)=3.0m,3.5m,4.0m. Vierendeel Constant span=10 m, and module = 6.0m .In wind and earthquakes cases in the direction-x and the ratio between the drifts in the wind to the drifts in earthquakes . The drifts in case of wind increased more than of earthquakes in the direction- x. As show the tables (1-2-3) below:-

Table (c-1): Relation between total drift (ΔX mm) of wind and earthquakes at (H=3.0m S=6.0m, L=10.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	62.98	121.58	52%
STORY24	62.46	120.13	52%
STORY23	61.80	118.38	52%
STORY22	60.98	116.26	52%
STORY21	59.95	113.72	53%
STORY20	58.72	110.81	53%
STORY19	57.28	107.49	53%
STORY18	55.64	103.83	54%
STORY17	53.78	99.80	54%
STORY16	51.73	95.45	54%
STORY15	49.47	90.77	55%
STORY14	47.02	85.81	55%
STORY13	44.35	80.53	55%
STORY12	41.52	75.00	55%
STORY11	38.47	69.17	56%
STORY10	35.26	63.13	56%
STORY9	31.84	56.80	56%
STORY8	28.28	50.28	56%
STORY7	24.52	43.48	56%
STORY6	20.64	36.53	57%
STORY5	16.60	29.34	57%
S TORY4	12.52	22.11	57%
STORY3	8.43	14.89	57%
STORY2	4.61	8.15	57%
STORY1	1.45	2.59	56%

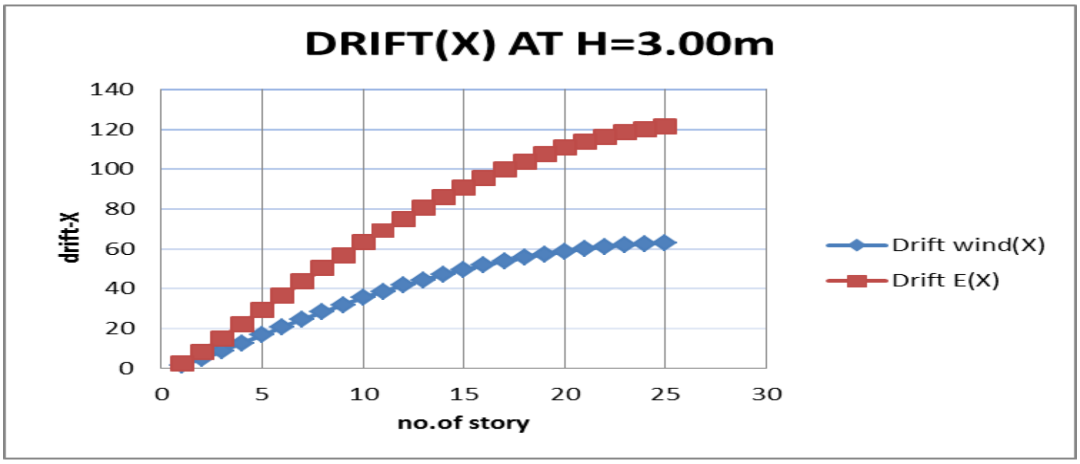


Table (c-2): Relation between total drift (ΔX mm) of wind and earthquakes at (H=3.5m S=6.0m, L=10.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	108.80	153.43	71%
STORY24	107.89	151.59	71%
STORY23	106.75	149.36	71%
STORY22	105.33	146.67	72%
STORY21	103.55	143.45	72%
STORY20	101.42	139.75	73%
STORY19	98.92	135.55	73%
STORY18	96.08	130.92	73%
STORY17	92.86	125.82	74%
STORY16	89.32	120.34	74%
STORY15	85.40	114.42	75%
STORY14	81.18	108.18	75%
STORY13	76.59	101.54	75%
STORY12	71.70	94.60	76%
STORY11	66.45	87.27	76%
STORY10	60.93	79.68	76%
STORY9	55.06	71.72	77%
STORY8	48.94	63.54	77%
STORY7	42.48	55.01	77%
STORY6	35.81	46.29	77%
STORY5	28.87	37.29	77%
S TORY4	21.83	28.22	77%
STORY3	14.76	19.11	77%
STORY2	8.11	10.54	77%
STORY1	2.57	3.39	76%

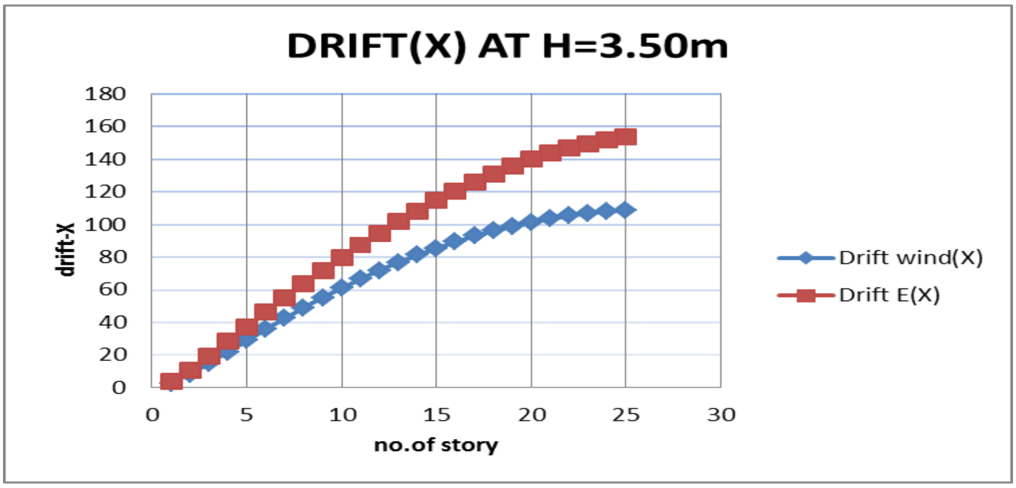
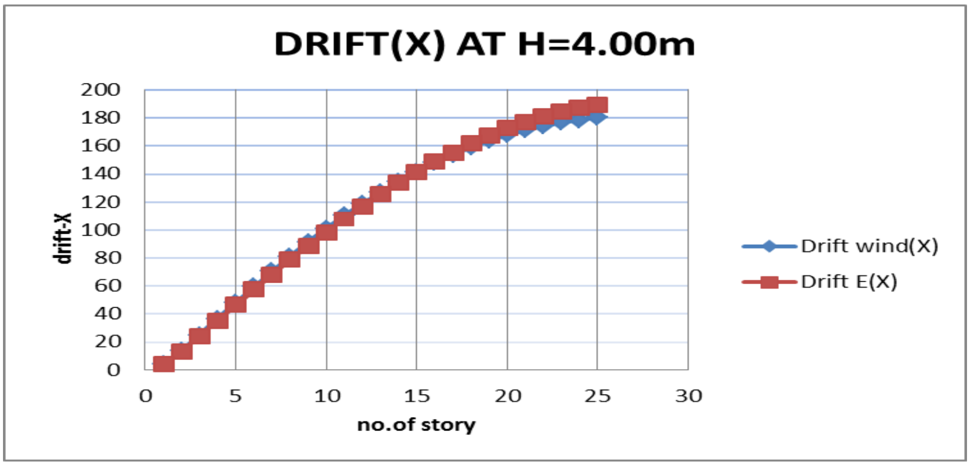


Table (c-3): Relation between total drift (ΔX mm) of wind and earthquakes at (H=4.0m S=6.0m, L=10.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	180.06	189.42	95%
STORY24	178.52	187.13	95%
STORY23	176.62	184.36	96%
STORY22	174.23	181.00	96%
STORY21	171.26	177.00	97%
STORY20	167.74	172.42	97%
STORY19	163.60	167.21	98%
STORY18	158.91	161.47	98%
STORY17	153.59	155.16	99%
STORY16	147.73	148.39	100%
STORY15	141.26	141.10	100%
STORY14	134.28	133.41	101%
STORY13	126.70	125.23	101%
STORY12	118.64	116.68	102%
STORY11	109.99	107.67	102%
STORY10	100.88	98.33	103%
STORY9	91.21	88.56	103%
STORY8	81.12	78.51	103%
STORY7	70.48	68.03	104%
STORY6	59.50	57.32	104%
STORY5	48.05	46.26	104%
S TORY4	36.43	35.13	104%
STORY3	24.71	23.91	103%
STORY2	13.64	13.29	103%
STORY1	4.35	4.31	101%



d) Relation between the ratio of total drift of wind in direction-Y to drifts earthquake in direction-Y by using UBC97:-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height(H)=3.0m,3.5m,4.0m. Vierendeel Constant span=10m, and module = 6.0m .In wind and earthquakes cases in the direction-y and the ratio between the drifts in the wind to the drifts in earthquakes . The drifts in case of wind increased more than of earthquakes in the direction- Y. As show the tables (1-2-3) below.

Table (d-1): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.0m S=6.0m, L=10.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	26.96	103.93	26%
STORY24	26.79	102.98	26%
STORY23	26.54	101.63	26%
STORY22	26.20	99.90	26%
STORY21	25.78	97.81	26%
STORY20	25.27	95.39	26%
STORY19	24.67	92.65	26%
STORY18	24.00	89.61	27%
STORY17	23.24	86.30	27%
STORY16	22.39	82.71	27%
STORY15	21.47	78.87	27%
STORY14	20.47	74.79	27%
STORY13	19.39	70.48	27%
STORY12	18.23	65.95	28%
STORY11	17.00	61.20	28%
STORY10	15.69	56.25	28%
STORY9	14.31	51.11	28%
STORY8	12.86	45.79	28%
STORY7	11.35	40.28	28%
STORY6	9.77	34.58	28%
STORY5	8.12	28.71	28%
S TORY4	6.42	22.66	28%
STORY3	4.66	16.44	28%
STORY2	2.85	10.09	28%
STORY1	1.10	3.94	28%

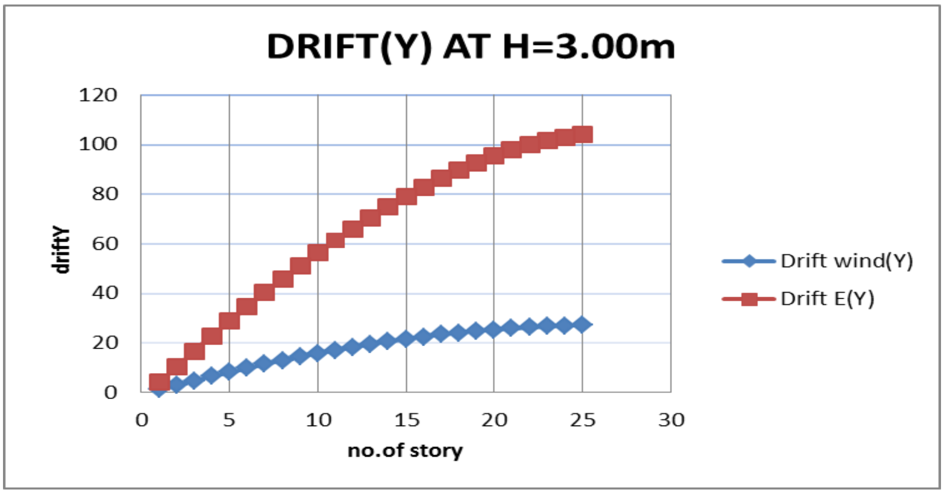


Table (d-2): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.5m S=6.0m, L=10.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	46.23	133.64	35%
STORY24	45.92	132.37	35%
STORY23	45.49	130.60	35%
STORY22	44.90	128.34	35%
STORY21	44.17	125.62	35%
STORY20	43.29	122.47	35%
STORY19	42.27	118.92	35%
STORY18	41.09	115.00	36%
STORY17	39.78	110.72	36%
STORY16	38.33	106.10	36%
STORY15	36.75	101.15	36%
STORY14	35.02	95.91	36%
STORY13	33.17	90.37	37%
STORY12	31.19	84.56	37%
STORY11	29.08	78.48	37%
STORY10	26.84	72.13	37%
STORY9	24.48	65.54	37%
STORY8	22.01	58.72	37%
STORY7	19.4	51.67	38%
STORY6	16.72	44.39	38%
STORY5	13.92	36.90	38%
S TORY4	11.01	29.20	38%
STORY3	8.01	21.29	38%
STORY2	4.95	13.19	38%
STORY1	1.95	5.27	37%

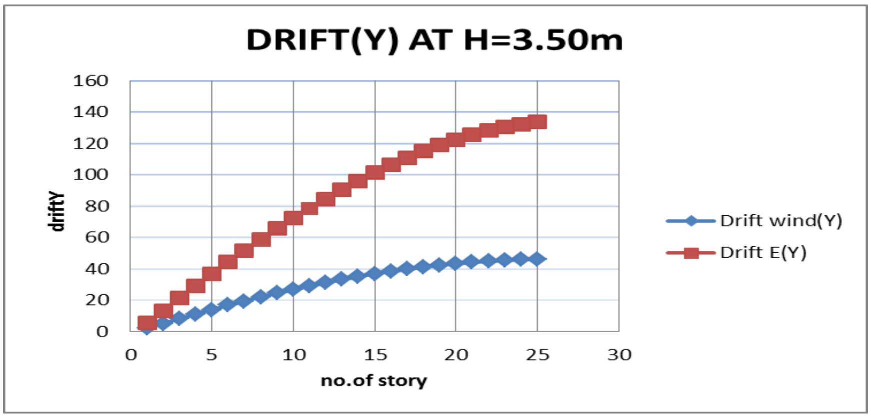
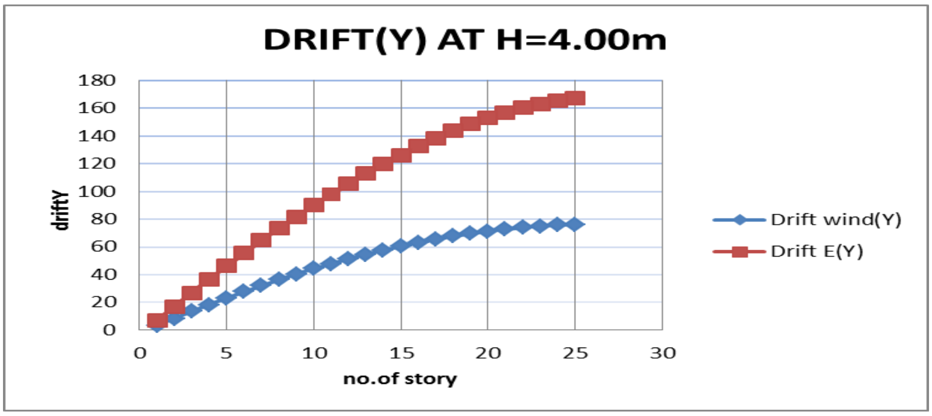


Table (d-3): Relation between total drift (ΔY mm) of wind and earthquakes at (H=4.0m S=6.0m, L=10.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	76.12	167.02	46%
STORY24	75.58	165.38	46%
STORY23	74.84	163.12	46%
STORY22	73.86	160.25	46%
STORY21	72.64	156.81	46%
STORY20	71.19	152.85	46%
STORY19	69.50	148.39	47%
STORY18	67.57	143.46	47%
STORY17	65.41	138.09	47%
STORY16	63.02	132.30	47%
STORY15	60.40	126.12	48%
STORY14	57.57	119.57	48%
STORY13	54.52	112.66	48%
STORY12	51.26	105.41	48%
STORY11	47.78	97.82	49%
STORY10	44.11	89.92	49%
STORY9	40.24	81.71	49%
STORY8	36.18	73.23	49%
STORY7	31.93	64.45	49%
STORY6	27.51	55.40	50%
STORY5	22.91	46.09	50%
S TORY4	18.16	36.55	50%
STORY3	13.25	26.77	49%
STORY2	8.22	16.73	49%
STORY1	3.29	6.81	48%



e) Relation between the ratio of total drift of wind in direction-X to drifts earthquake in direction-X by using UBC97:-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height(H)=3.0m,3.5m,4.0m. Vierendeel Constant span=12m, and module = 6.0m .In wind and earthquakes cases in the direction-x and the ratio between the drifts in the wind to the drifts in earthquakes . The drifts in case of wind increased more than of earthquakes in the direction- x. As show the tables (1-2-3) below.

Table (e-1): Relation between total drift (ΔX mm) of wind and earthquakes at (H=3.0m S=6.0m, L=12.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	68.91	147.03	47%
STORY24	68.39	145.39	47%
STORY23	67.73	143.40	47%
STORY22	66.88	140.95	47%
STORY21	65.81	138.01	48%
STORY20	64.51	134.59	48%
STORY19	62.97	130.67	48%
STORY18	61.21	126.31	48%
STORY17	59.20	121.48	49%
STORY16	56.98	116.26	49%
STORY15	54.51	110.61	49%
STORY14	51.83	104.61	50%
STORY13	48.91	98.20	50%
STORY12	45.79	91.47	50%
STORY11	42.43	84.36	50%
STORY10	38.88	76.96	51%
STORY9	35.10	69.20	51%
STORY8	31.15	61.20	51%
STORY7	26.98	52.85	51%
STORY6	22.66	44.31	51%
STORY5	18.18	35.51	51%
S TORY4	13.65	26.66	51%
STORY3	9.14	17.86	51%
STORY2	4.95	9.70	51%
STORY1	1.54	3.05	51%

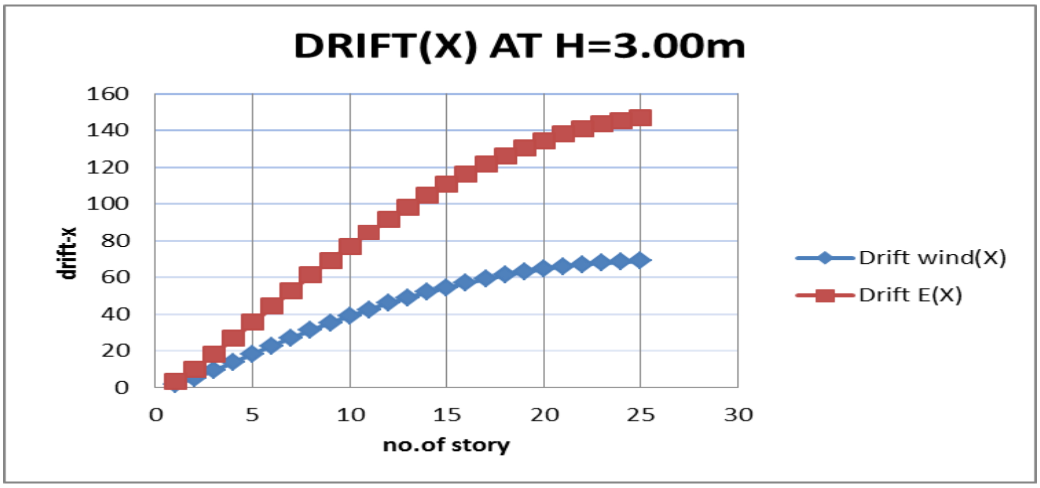


Table (e-2): Relation between total drift (ΔX mm) of wind and earthquakes at (H=3.50m S=6.0m, L=12.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	118.16	183.66	64%
STORY24	117.28	181.62	65%
STORY23	116.16	179.14	65%
STORY22	114.72	176.08	65%
STORY21	112.89	172.39	65%
STORY20	110.67	168.11	66%
STORY19	108.03	163.21	66%
STORY18	105.01	157.77	67%
STORY17	101.57	151.74	67%
STORY16	97.75	145.23	67%
STORY15	93.53	138.18	68%
STORY14	88.94	130.71	68%
STORY13	83.95	122.74	68%
STORY12	78.62	114.38	69%
STORY11	72.88	105.53	69%
STORY10	66.82	96.34	69%
STORY9	60.37	86.70	70%
STORY8	53.63	76.76	70%
STORY7	46.51	66.38	70%
STORY6	39.15	55.77	70%
STORY5	31.49	44.82	70%
S TORY4	23.72	33.80	70%
STORY3	15.95	22.79	70%
STORY2	8.69	12.49	70%
STORY1	2.72	3.97	69%

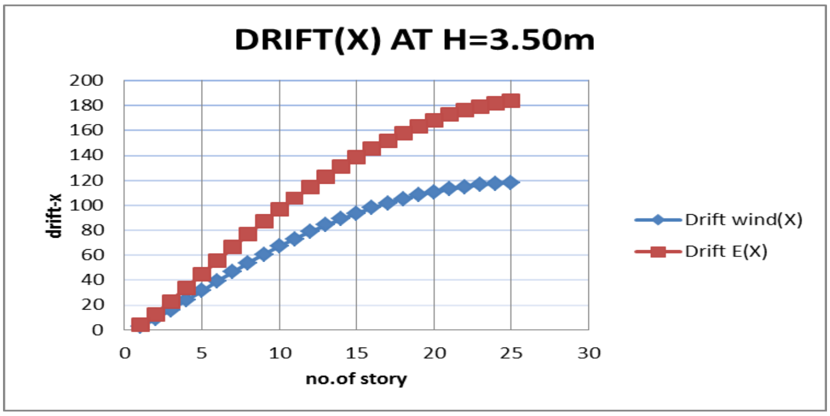
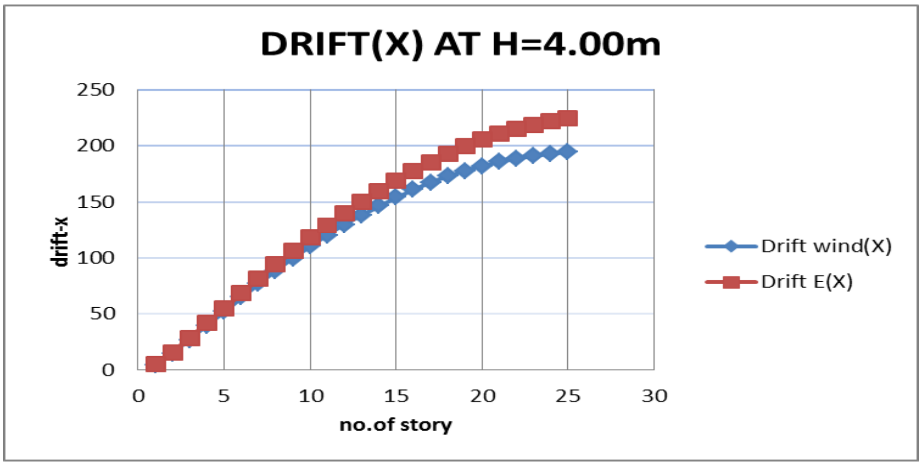


Table (e-3): Relation between total drift (ΔX mm) of wind and earthquakes at (H=4.0m S=6.0m, L=12.m) deferent stories:-

Story	Drift WX(mm)	Drift EX(mm)	Ratio(Drift(WX)/Drift(EX)%
STORY25	194.31	224.22	87%
STORY24	192.85	221.74	87%
STORY23	190.99	218.70	87%
STORY22	188.61	214.97	88%
STORY21	185.59	210.45	88%
STORY20	181.95	205.21	89%
STORY19	177.63	199.21	89%
STORY18	172.68	192.56	90%
STORY17	167.04	185.20	90%
STORY16	160.78	177.26	91%
STORY15	153.85	168.68	91%
STORY14	146.34	159.58	92%
STORY13	138.15	149.88	92%
STORY12	129.42	139.70	93%
STORY11	120.02	128.94	93%
STORY10	110.10	117.78	93%
STORY9	99.54	106.07	94%
STORY8	88.50	93.99	94%
STORY7	76.85	81.38	94%
STORY6	64.78	68.46	95%
STORY5	52.22	55.14	95%
S TORY4	39.46	41.75	95%
STORY3	26.64	28.30	94%
STORY2	14.59	15.63	93%
STORY1	4.60	5.03	91%



f) Relation between the ratio of total drift of wind in direction-Y to drifts earthquake in direction-Y by using UBC97:-

The tables below shows the relationship between the drifts of Diaphragm at building Consists of (25-stories for story height(H)=3.0m, 3.5m, 4.0m. Vierendeel Constant span=12m, and module = 6.0m. In wind and earthquakes cases in the direction-y and the ratio between the drifts in the wind to the drifts in earthquakes. The drifts in case of wind increased more than of earthquakes in the direction- Y. As show the tables (1-2-3) below.

Table (f-1): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.0m) S=6.0m, L=12.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	30.87	116.13	27%
STORY24	30.67	115.06	27%
STORY23	30.39	113.55	27%
STORY22	30.00	111.62	27%
STORY21	29.51	109.28	27%
STORY20	28.93	106.56	27%
STORY19	28.25	103.50	27%
STORY18	27.47	100.11	27%
STORY17	26.60	96.40	28%
STORY16	25.64	92.39	28%
STORY15	24.58	88.10	28%
STORY14	23.43	83.54	28%
STORY13	22.19	78.72	28%
STORY12	20.87	73.66	28%
STORY11	19.46	68.36	28%
STORY10	17.96	62.83	29%
STORY9	16.38	57.08	29%
STORY8	14.72	51.13	29%
STORY7	12.99	44.97	29%
STORY6	11.18	38.61	29%
STORY5	9.29	32.05	29%
S TORY4	7.34	25.30	29%
STORY3	5.32	18.36	29%
STORY2	3.26	11.27	29%
STORY1	1.26	4.42	29%

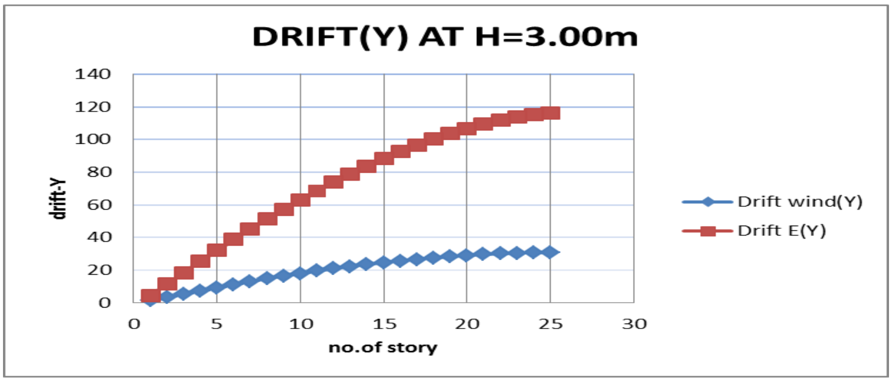


Table (f-2): Relation between total drift (ΔY mm) of wind and earthquakes at (H=3.50m) S=6.0m, L=12.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	52.97	148.86	36%
STORY24	52.61	147.44	36%
STORY23	52.11	145.46	36%
STORY22	51.44	142.94	36%
STORY21	50.60	139.90	36%
STORY20	49.59	136.39	36%
STORY19	48.42	132.44	37%
STORY18	47.07	128.07	37%
STORY17	45.57	123.29	37%
STORY16	43.91	118.14	37%
STORY15	42.09	112.63	37%
STORY14	40.12	106.79	38%
STORY13	37.99	100.63	38%
STORY12	35.72	94.16	38%
STORY11	33.30	87.38	38%
STORY10	30.74	80.32	38%
STORY9	28.04	72.98	38%
STORY8	25.20	65.38	39%
STORY7	22.23	57.53	39%
STORY6	19.14	49.42	39%
STORY5	15.93	41.08	39%
S TORY4	12.60	32.51	39%
STORY3	9.17	23.71	39%
STORY2	5.66	14.70	38%
STORY1	2.23	5.89	38%

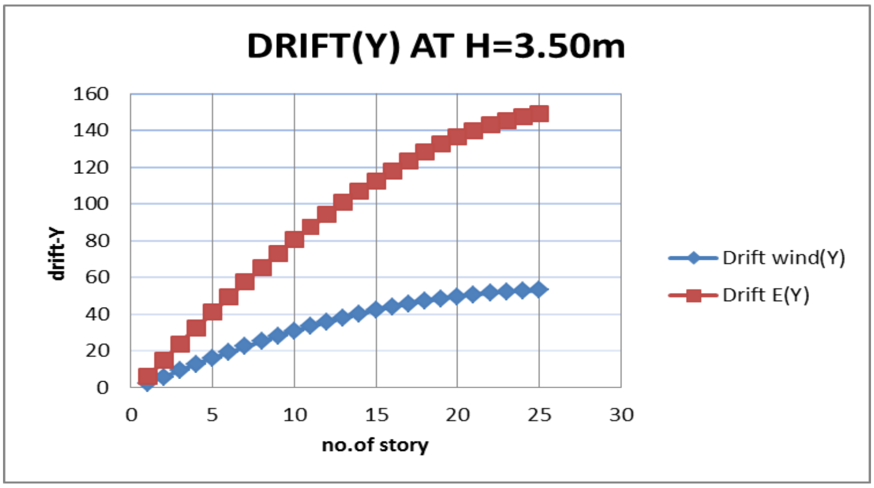
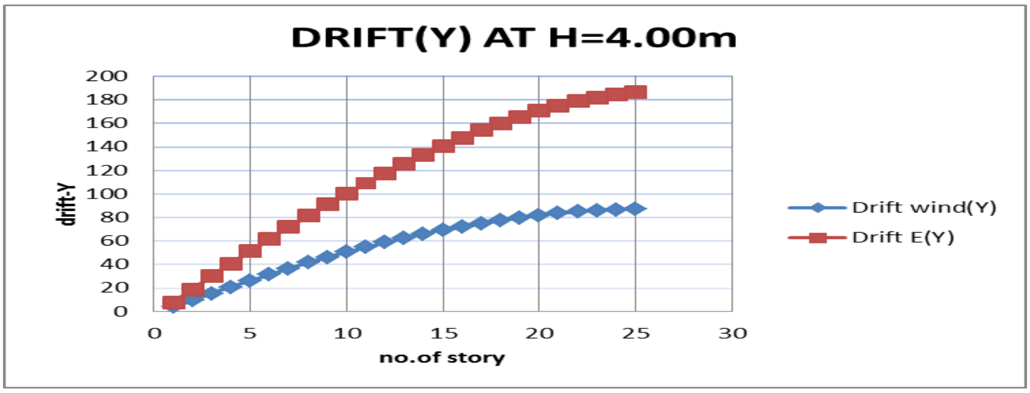


Table (f-3): Relation between total drift (ΔY mm) of wind and earthquakes at (H=4.00m) S=6.0m, L=12.m) deferent stories:-

Story	Drift WY(mm)	Drift EY(mm)	Ratio(Drift(WY)/Drift(EY)%
STORY25	87.25	186.13	47%
STORY24	86.64	184.30	47%
STORY23	85.78	181.78	47%
STORY22	84.66	178.57	47%
STORY21	83.26	174.74	48%
STORY20	81.59	170.31	48%
STORY19	79.65	165.34	48%
STORY18	77.45	159.85	48%
STORY17	74.97	153.86	49%
STORY16	72.23	147.40	49%
STORY15	69.23	140.51	49%
STORY14	65.98	133.20	50%
STORY13	62.48	125.50	50%
STORY12	58.74	117.42	50%
STORY11	54.76	108.95	50%
STORY10	50.55	100.15	50%
STORY9	46.11	91.00	51%
STORY8	41.45	81.54	51%
STORY7	36.58	71.76	51%
STORY6	31.51	61.68	51%
STORY5	26.24	51.29	51%
S TORY4	20.79	40.68	51%
STORY3	15.16	29.80	51%
STORY2	9.41	18.64	50%
STORY1	3.76	7.62	49%



CONCLUSION

From the results of this study, the following items have been found:

1. Total drift in case of earthquake are bigger than wind in two directions (x) & (y).
2. Story height is the most governing parameter that affects building total drift.
3. Total drift in cases of earthquake and wind in direction-x increase(parallel with Vierendeel) more than direction-y(perpendicular on Vierendeel).
4. The results of total drifts in cases of earthquake and wind in direction –x converge at increase the height and span of Vierendeel .
5. Total drift increase for buildings that have higher module span considering the Effect of Vierendeel span on total drift at Constant Story height.
6. Total drift increase for buildings that have higher Vierendeel span and higher story height considering the effect of story height on total drift at Constant Vierendeel Span.
7. Total drift increase for buildings that have higher module span considering the effect of story height on total drift at Constant Vierendeel Span.

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