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Comparative Study of Wind Dynamic Effect in Different Topographies on G+29 High Rise Building

Swetha P | Sahithi K

Department of Civil Engineering, UCET, Perecherla, Andhra pradesh, India

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ABSTRACT

The direction and speed of the wind can be greatly affected by topographyreducing wind throw hazard has become a management issue in many parts of the world. A study is identifying differences in wind exposure between different topographic positions, taking into account the wind origin. Hilltops were found to be severely exposed to wind from all directions. Wind speed in the valleys varied with the direction of the approaching wind and the general form of the valley. Local topographic factors inside a valley will also influence greatly wind speed and direction. An attention should be paid to locating places where the valley widens when leaving buffer strips along rivers. Forest strips left along rivers will probably suffer less damage than those at right angles to the valleys axis. Hazards would be particularly high for strips left on hilltops.

In this paper we comparing wind dynamic effect on high rise building in different topographies.A reduction in wind speed was observed for wind blowing across valleys. For the noire river valley, the most important reduction was associated with winds form ὼ but the coefficient of variation is high, suggesting that the flow at the bottom of the valley is highly variable for this wind direction. In fact, if we examine the maximum and minimum over speed ratios for this direction, we see that sensors 15 and 16 are exposed to winds slightly stronger than approaching winds whereas 18 is exposed.

When wind blows in line with the valleys and hills, the shelter provided by the topography is low and is influenced by local topographic features.We need to conclusion about the structure in which topographic factor it would be in more economical.

Key words: Diagrid, Wind dynamic effect, High-rise buildings, Topographies, Gust factor, Inter story drift, Lateral force, Lateral displacement, Etabs.

1.INTRODUCTION

The development of new construction techniques has created structures that are flexible, low in damping and light in weight which therefore exposes the structure to the effect of wind acting upon it. There is very much need of ensure the performance of the structure subjected to the action of wind to be within adequate limits during the life time of the structural safety and serviceability criteria. The standard wind speed over a time period of the order of ten minutes or more tends to increase with height, while the gustiness tends to decrease with height.Tall structure is designed to act as vertical cantilever beams and it is possible that High rise building will be affected by wind. It is very essential that the fluctuating loads caused by wind on a structure play acrucial role in the design and analysis of tall buildings, especially structure with large aspect ratios.

The first reason is to choosetopographies is the rapid increasing in population people want to live hill areas, valleys. Hilltops are exposed to stronger winds than other topographic units and, whatever the wind origin, the wind is 1.75-2 times the approaching speed. Winds are not deflected and they show little variation around the mean direction, leading to r mean values greater than 0.98.

Valleys are generally known to offer some shelter, but the degree of shelter varies with the shape of the valley and the direction of the approaching winds. The fact that portions of valleys oriented NE-SW had higher mean over speed rations compared with the Montmorency river valley can be attributed to their winder valley profile and their higher altitude.

Load Calculation:

Dead Load:

Dead load is the essential weight of a structure which is immovable. Dead load has been considered

Floor finish = 1 kN/m²,

Additional Dead load = 0.5 kN/m²from IS 875: Part-1 1987 Code

Live Load:

Live load is an engineering term that refers to the weight of people or goods in building, Live load has beenconsidered 2kN/m² as per IS 875: Part-2 1987 Code

Wind Load:

As per IS 875 (PART-3) 2015

Design wind speed

Basic wind speed Vb =50 m/sec in Visakhapatnam

Risk Coefficient K1 = 1

Terrain, height and structure size factor K2 = 1

Topography factors-$K3_1$ = 1.00

$K3_2$ = 1.12

$K3_3$ = 1.24

$K3_4$ = 1.36

Importance factor for the cyclonic region (K4)= 1

Gust Factor from IS-875 (part-3) 2015:(Along 'X and Y' direction)

$$G = 1 + r\sqrt{\left[g_v^2 B_s (1+g)^2 + \frac{H_s g_R^2 SE}{\beta}\right]}$$

	Topography Factor – 1.00	Topography Factor – 1.12	Topography Factor – 1.24	Topography Factor – 1.36
Peak factor for Upwind gv	3	3	3	3
Height factor Hs	2	2	2.44	2.44
Background Factor Bx	0.912	0.912	0.912	0.912
By	0.89	0.89	0.89	0.89
Turbine intensity factor gx	0.526	0.526	0.526	0.526
gy	0.51	0.51	0.51	0.51
Peak factor for resonant response gRx	3.92	3.92	3.92	3.92
gRy	3.89	3.89	3.89	3.89
Size reduction factor Sx	0.077	0.09	0.102	0.115
Sy	0.079	0.092	0.106	0.119
Spectrum of Turbulence Ex	0.053	0.053	0.053	0.053
Spectrum of Turbulence Ey	0.057	0.057	0.057	0.057
Damping Coefficient β	0.02	0.02	0.02	0.02
Gust Factor Gx	4.709	4.826	4.95	5.07
Gust Factor Gy	4.712	4.840	4.957	5.115

Methodology:

In this study comparison of wind dynamic effect in different topographic factors on G+29 high rise structure, Section properties and Material properties are defined.Loading are given, Support conditions given and Analysis carried out.Wind forces have been calculated for the structure.Wind forces has been assigned as per IS guidelines and analysis carried out.

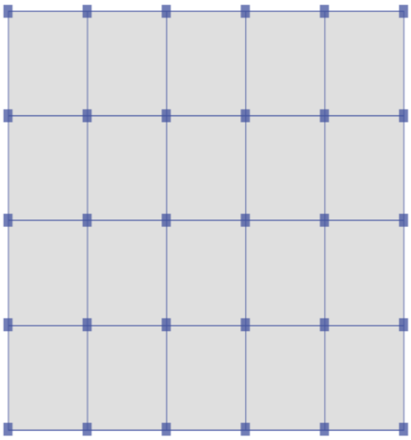


Fig. 1 ETABS Model –

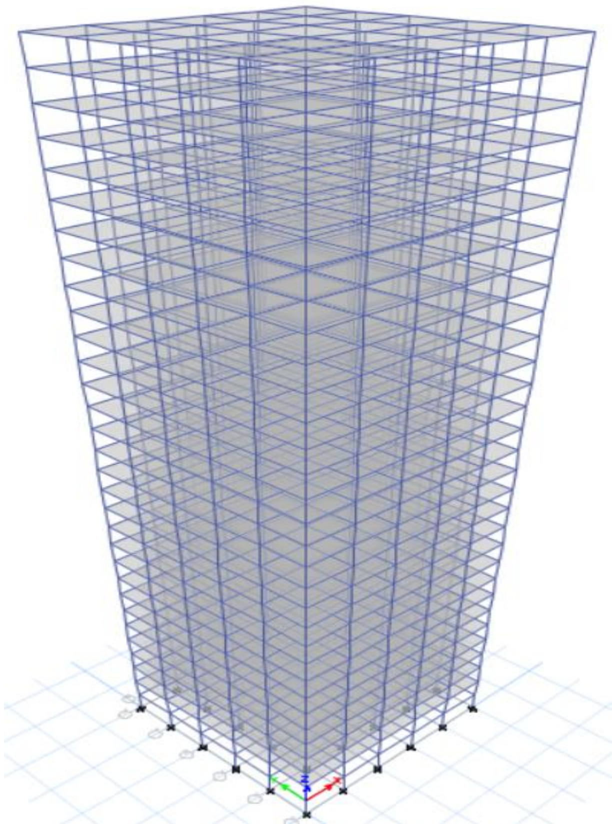


Fig .2 Structural 3D View

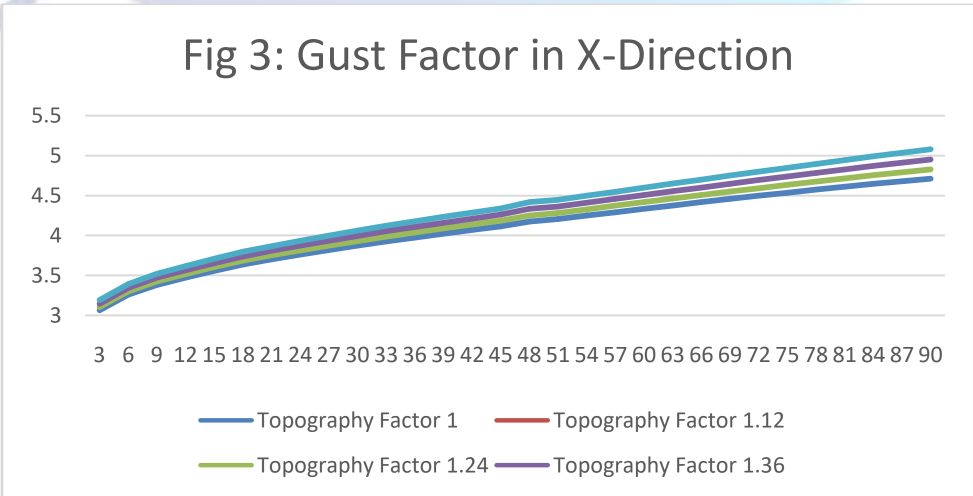
RESULTS AND DISCUSSION

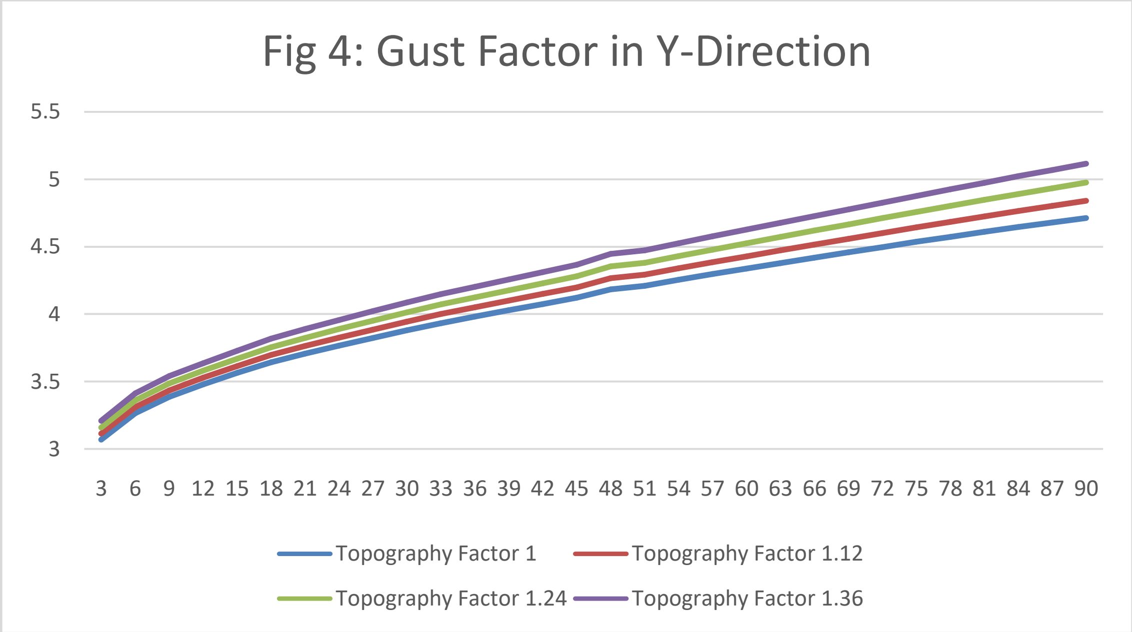
Results of different parameters such as Gust factor, Lateral force,Lateral displacement, Interstorey drift and turbulence intensity are shown below with the help of graphs.

The Gust factor method is easy to study the dynamic effect on the structure and critical path of the wind loads for the tall buildings. Maximum Gust factor along X - direction and Y-direction are mentioned below.

	X-dir	Y-dir
Topography Factor – 1.00	4.709	4.712
Topography Factor – 1.12	4.826	4.840
Topography Factor – 1.24	4.950	4.975
Topography Factor – 1.36	5.079	5.115

The Gust factor has increased 7.28% in X-direction and 7.88%in Y-direction. The **FIG 3** and **FIG 4** shows the variance in Gust factor for different topographic factors.

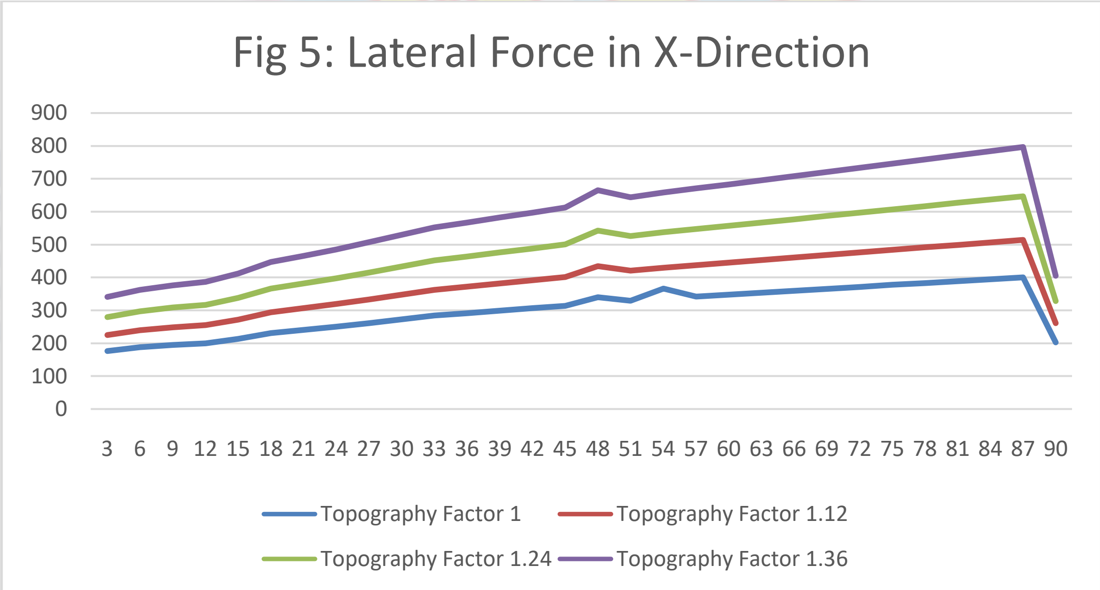


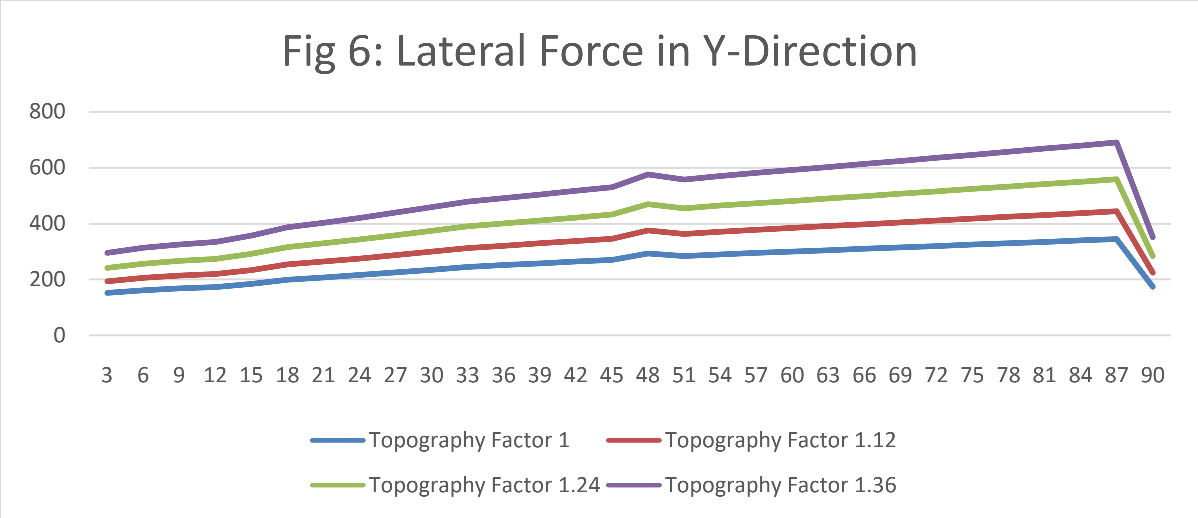


MaximumLateral forces of the Structure along X -direction and Y-direction are mentioned below.

	X-dir	Y-dir
Topography Factor – 1.00	400.35	344.58
Topography Factor – 1.12	514.35	443.69
Topography Factor – 1.24	646.20	558.63
Topography Factor – 1.36	797.00	690.44

The Lateral force has increased 49.96 % in X-direction and 50.09% Y-direction. The **FIG 5** and **FIG 6** show the variance in the Lateral force for different topographic factors.

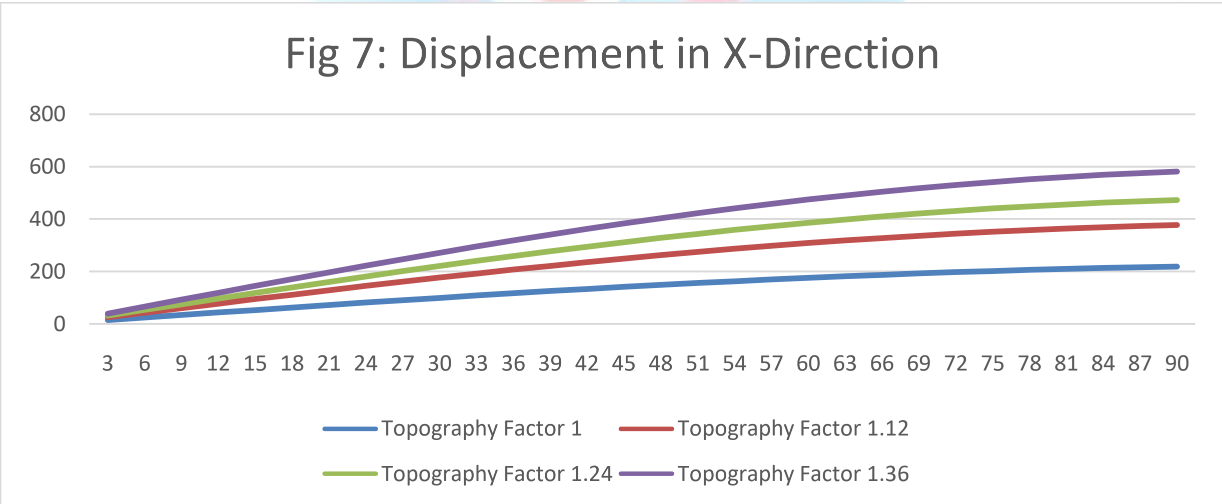


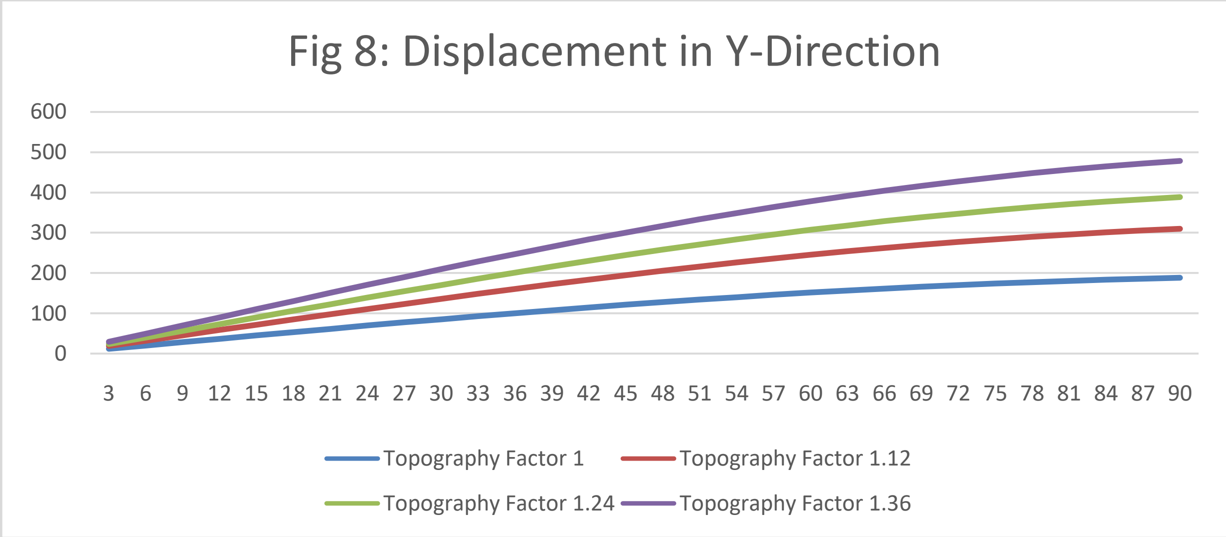


MaximumLateral Displacement of the Structure along X - direction and Y-direction are mentioned below.

	X-dir	Y-dir
Topography Factor – 1.00	219.09	188.65
Topography Factor – 1.12	377.66	310.16
Topography Factor – 1.24	467.89	383.69
Topography Factor – 1.36	580.74	478.74

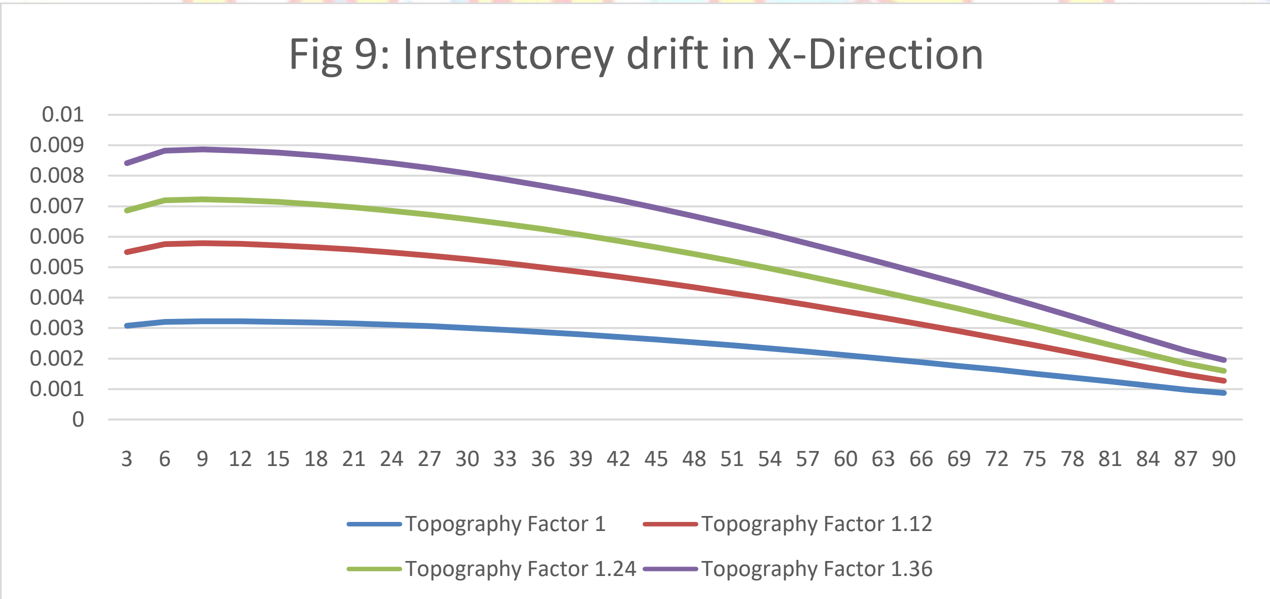
The Lateral force has increased 62.27%in X-direction and 60.59% in Y-direction. The **FIG 7** and **FIG 8** show the variance in the Lateral force for different topographic factors.

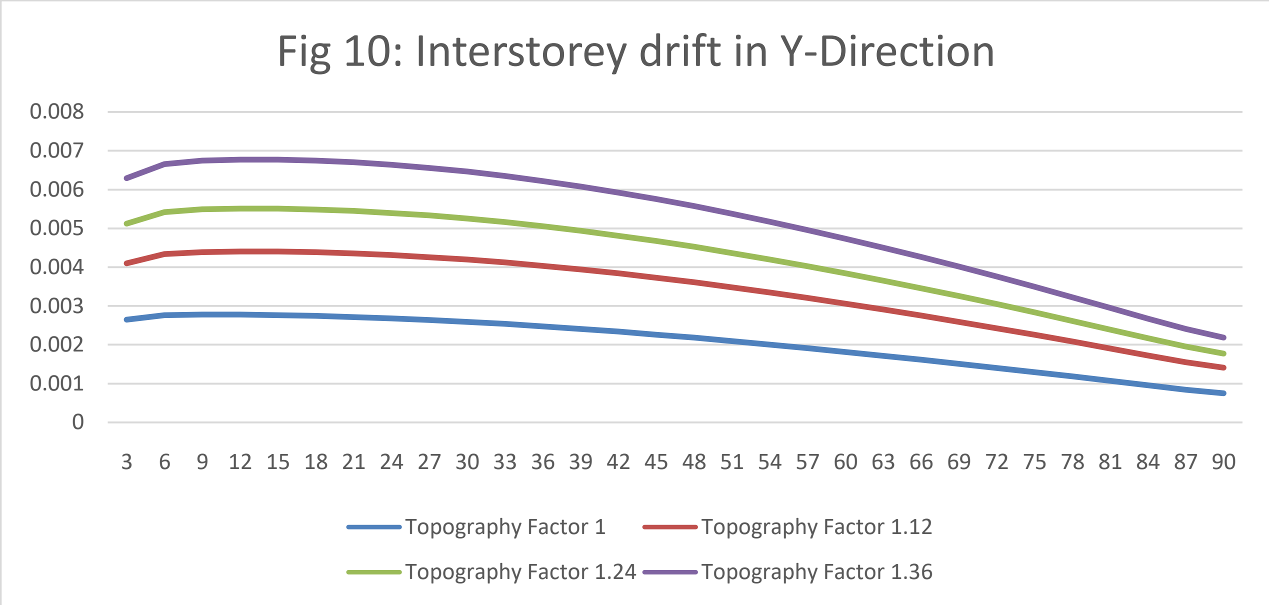




MaximumInter storey drift of the Structure along X - direction and Y-direction are mentioned below.

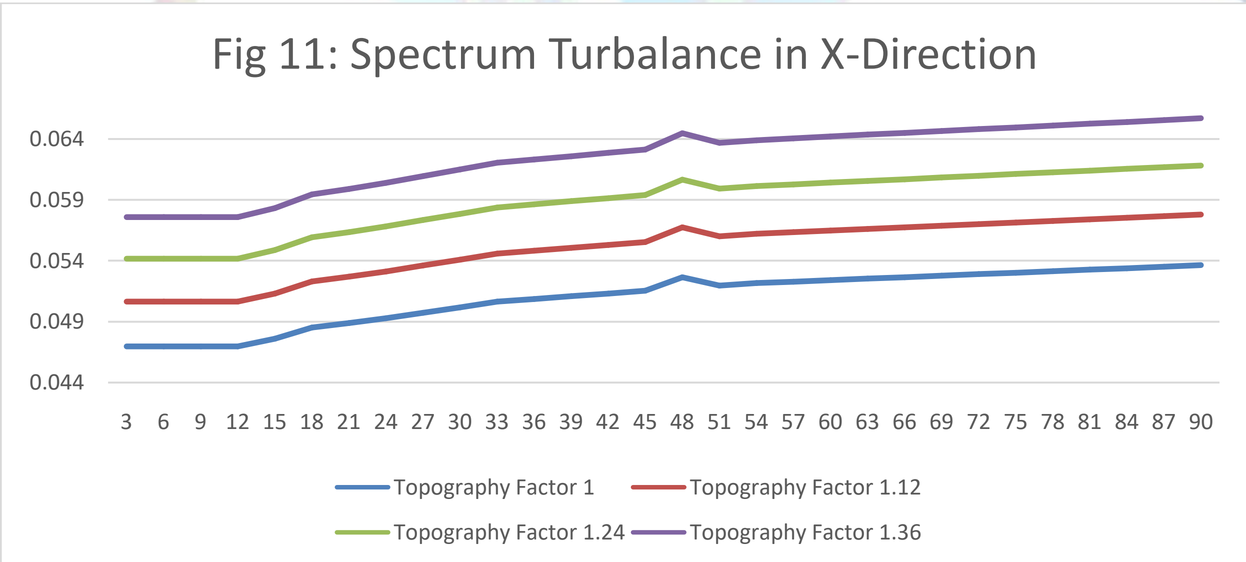
	X-dir	Y-dir
Topography Factor – 1.00	0.00086	0.00074
Topography Factor – 1.12	0.0012	0.0014
Topography Factor – 1.24	0.0018	0.0019
Topography Factor – 1.36	0.0019	0.0021

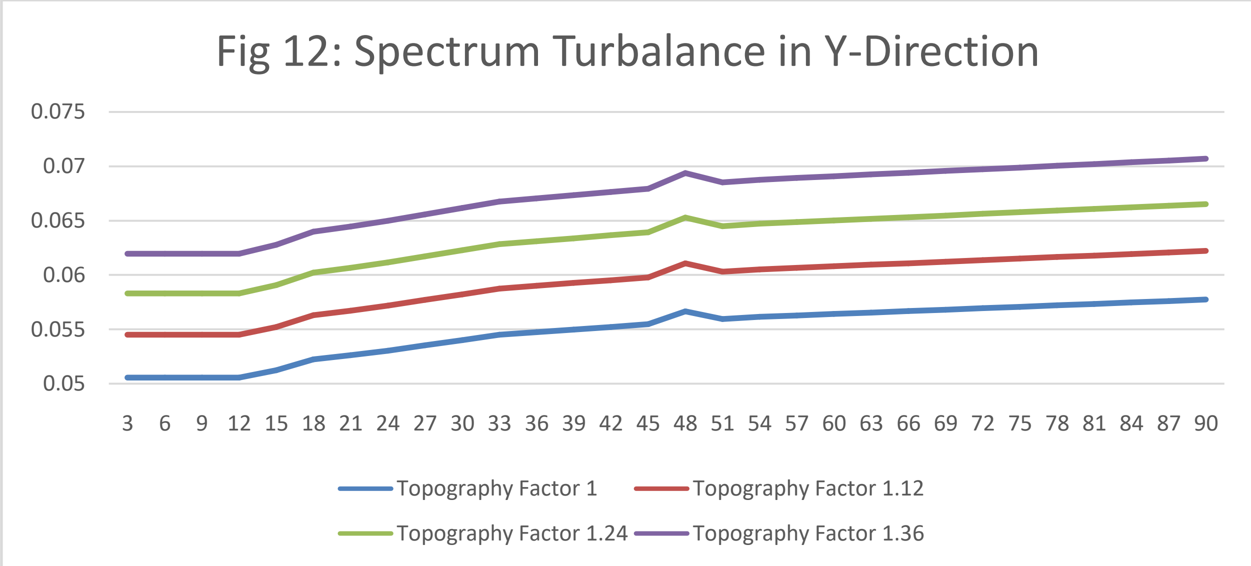




The Inter storey drift has increased 54.73%in X-direction and 64.76% in Y-direction. The **FIG 9** and **FIG 10** show the variance in the Inter storey drift for different topographic factors.
Turbulence intensity of the Structure along X - direction and Y-direction are mentioned below

	X-dir	Y-dir
Topography Factor – 1.00	0.053	0.057
Topography Factor – 1.12	0.057	0.062
Topography Factor – 1.24	0.061	0.066
Topography Factor – 1.36	0.065	0.07





The turbulence intensity has increased 18.46% in X-direction and 18.57% in Y-direction. The **FIG 11** and **FIG 12** show the variance in the turbulence intensity for different topographic factors.

CONCLUSION

1. Percentage of Gust factor, Lateral force, Lateral displacement, Inter story drift,turbulence intensityhas been increased withdifferent topographic factors.
2. **Gust factor** has been increased 7.28% in X-direction and 7.88% in Y-direction indifferent topographic factors**.**
3. **Lateral Force** has been increased 49.96% in X-direction and 50.09% in Y-direction in different topographic factors.
4. **Lateral Displacement** has been increased 62.27% in X-direction and 60.59% in Y-direction indifferent topographic factors.
5. **Inter storey drift** has been increased 54.73% in X-direction and 64.76% in Y-direction indifferent topographic factors.
6. **Turbulence intensity** has been increased 18.46% in X-direction and 18.76% in Y-direction indifferent topographic factors.
7. The structure is economically more at topographic factor 1.36

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