

Analysis & Design of Sloped Ground Building with Shear walls under Seismic Loads

D.Kiranmai¹, B.K.Vishwanath²

P.G. Student, Department of Civil Engineering, Dr.K.V.Subba Reddy Institute of Technology, Kurnool, AP, India¹

Assistant Professor, Department of Civil Engineering, Dr.K.V.Subba Reddy Institute of Technology, Kurnool, AP, India²

ABSTRACT: The economic growth & rapid urbanization in hilly region has accelerated the real estate development. Due to this, population density in the hilly region has increased enormously. Since level land in hilly regions is very limited, there is a pressing demand to construct buildings on hill slope. A sloped ground building of 15 stories is analysed after considering shear walls to building frames, a better performance can be observed. In the present study the effect bracings in high rise RC structures sited in different types of earthquake zones (Z-III & V) and type of soils(S-I,S-II,S-III) using SAP2000 is done and results of torsion at highest and lowest elevation.

KEYWORDS: Sloped Ground Building, Bracings, Dynamic Analysis.

I. INTRODUCTION

Seismic analysis is a method to carry out the response of the building structure during ground motions. It is a part of process structural design, which includes seismic assessments of the buildings and also the retrofitting measures to strengthen the retaining structure in the seismic regions. In recent days the buildings with irregular configurations in both plan and elevation are common. These buildings asymmetry will suffer severely during earthquakes and undergo coupled torsion and lateral motions. A building can be designed to be earthquake proof for a rare but strong earthquake proof, but such buildings will be more expensive. The most logical approach to seismic design problem is to accept the uncertainty of the seismic phenomenon.

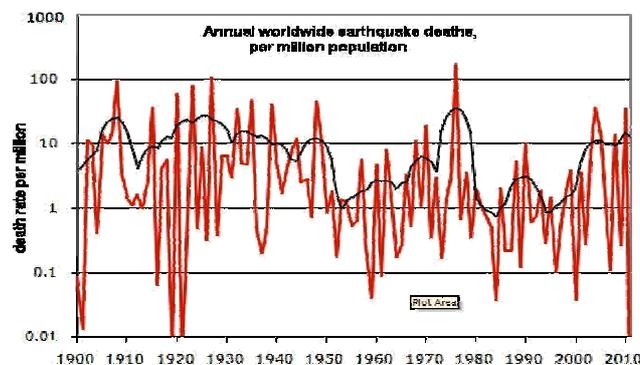


Fig 1: Worldwide earthquake Deaths

The analysis procedure teaches us how to identify the seismic forces and its demand. Depending upon the type of structure and its cost, the method of analyzing the structure varies from linear to non linear. The static non – procedure

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Vol. 7, Issue 6, June 2018

indicates which part of the building fails first and the elements begin to yield and deform in elastically as the load and displacement increases. Thus the resulting curve shows the capacity of the building and demand for the specific intensity of seismic forces, this resulting graph will generate a point on the curve where the capacity and demand will meet and we get a performance point. This point can be actually considered as the actual displacement of the structure in response to the specified lateral ground forces.

At last, this procedure gives the engineer a better understanding of the seismic characteristics of the structure and results in more logical and effective designs in future buildings and will be more economical for the retrofitting strategy of an existing building. The guidelines which recommends on these topics are ATC-40 and FEMA-356.

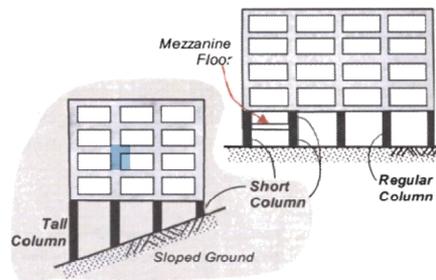


Fig 2: Shows Short column & Regular Column

II. NUMERICAL MODELING

Grid : 6 x 6

Height of The Building : 45m (15 Floors)

Area : 30m X 30m

Materials Used : M 25 , HYSD 415

Column Sizes Used : 600 X 750 mm²

Beams Sizes Used : 450 X 600 mm²

Slab Size Used : 120 mm

Shear wall Size : Slab 110mm

Loads Acting on Building :

Live Load : 3 kn/m²

Floor Finish Load : 1.5 kn/m²

Wall Load : 13 kn/m²

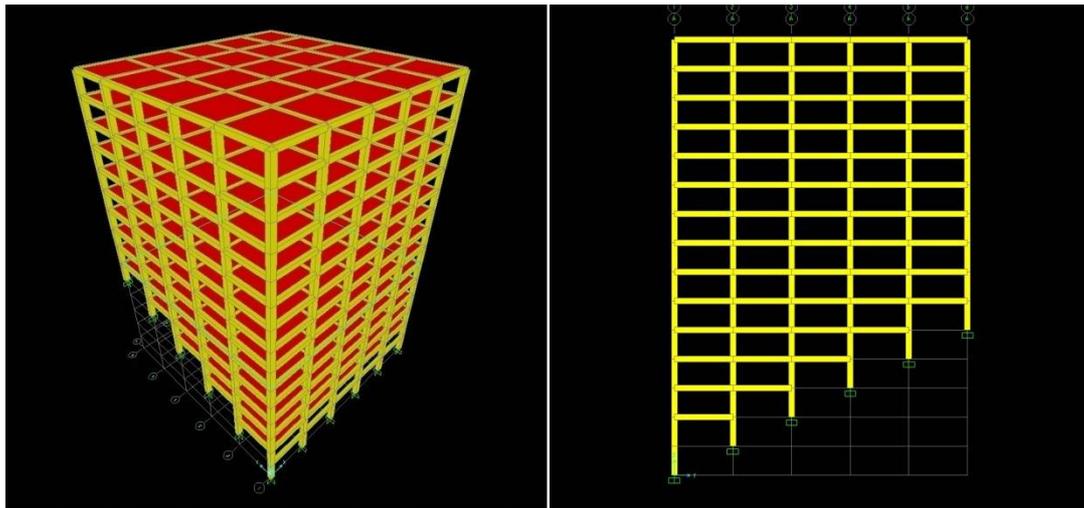
Load Combinations : 1.2(D.L+ L.L+E_{QX}), 1.2(D.L+L.L+E_{QY})

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Vol. 7, Issue 6, June 2018



III. RESULTS

Table 4.1 : Comparative Values of Torsion of A Building in Zone 3 & Soil 1 At Higher Elevation in Linear Static Analysis

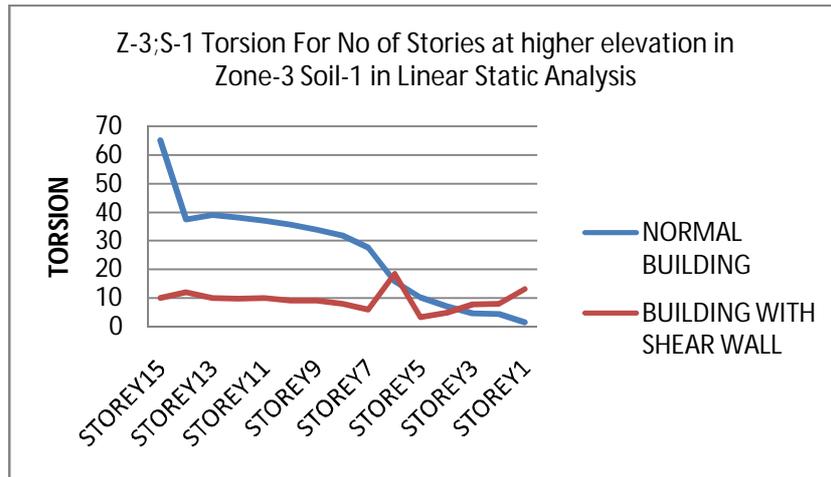
Storey	Normal Building	Building With Shear wall
Storey 14	-0.44	-3.22
Storey 13	-0.17	-0.97
Storey 12	-0.24	-1.3
Storey 11	-0.22	-1.25
Storey 10	-0.21	-1.22
Storey 9	-0.2	-1.16
Storey 8	-0.19	-1.09
Storey 7	-0.18	-1
Storey 6	-0.17	-0.9
Storey 5	-0.17	-0.79
Storey 4	-0.2	-0.66
Storey 3	-0.25	-0.47
Storey 2	-0.23	-0.45
Storey 1	-0.3	0.03
Base	0	0

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(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 6, June 2018



Graph 4.1 :Showing Variation of Torsion of A Building in Zone-3 &Soil-1 At Higher Elevation In Linear Static Analysis

Table 4.2 : Comparative Values of Torsion of A Building in Zone 3 & Soil 1 At Lower Elevation in Linear Static Analysis

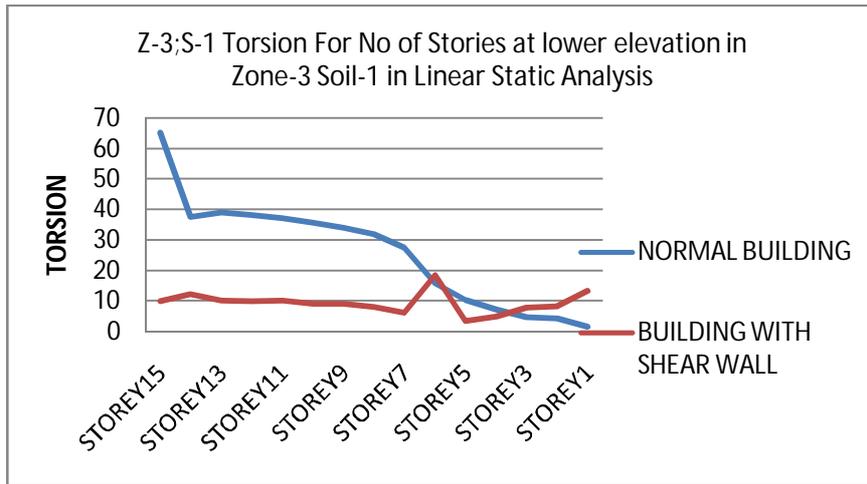
Storey	Normal Building	Building With Shear wall
Storey 9	0.52	2.31
Storey 8	0.19	0.66
Storey 7	0.25	0.86
Storey 6	0.24	0.82
Storey 5	0.23	0.77
Storey 4	0.21	0.7
Storey 3	0.2	0.6
Storey 2	0.18	0.54
Storey 1	0.11	0.29
Base	0.69	0.58

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 6, June 2018



Graph 4.2 : Showing Variation of Torsion of A Building in Zone-3 & Soil-1 At Lower Elevation In Linear Static Analysis

Table 4.3 : Comparative Values of Torsion of A Building in Zone 3 & Soil 2 At Higher Elevation in Linear Static Analysis

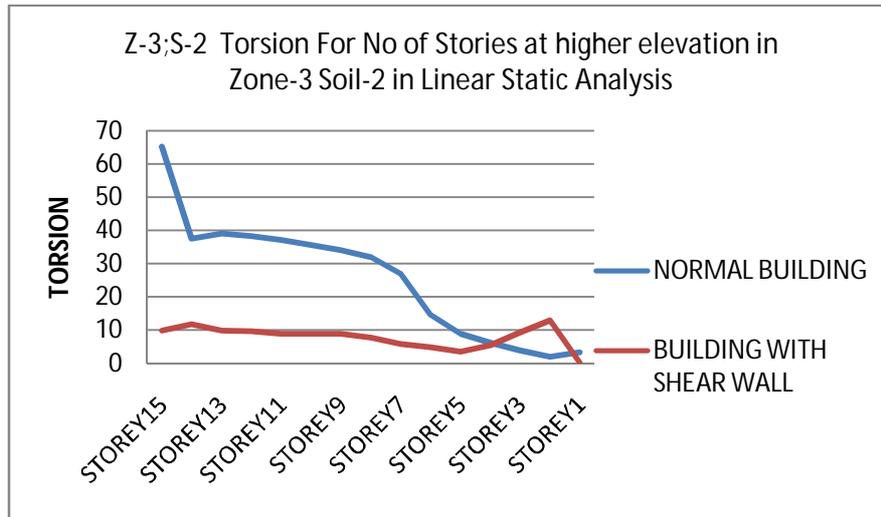
Storey	Normal Building	Building With Shear wall
Storey 14	-0.44	-3.31
Storey 13	-0.17	-1.01
Storey 12	-0.24	-1.32
Storey 11	-0.22	-1.28
Storey 10	-0.21	-1.25
Storey 9	-0.2	1.18
Storey 8	-0.19	-1.11
Storey 7	-0.18	-1.01
Storey 6	-0.18	-0.91
Storey 5	-0.24	-0.81
Storey 4	-0.31	-0.7
Storey 3	-0.33	-0.5
Storey 2	-0.3	-0.48
Storey 1	-0.05	-0.02
Base	0	0

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Vol. 7, Issue 6, June 2018



Graph 4.3 : Showing Variation of Torsion of A Building in Zone-3 & Soil-2 At Higher Elevation In Linear Static Analysis

Table 4.4 : Comparative Values of Torsion of A Building in Zone 3 & Soil 2 At Lower Elevation in Linear Static Analysis

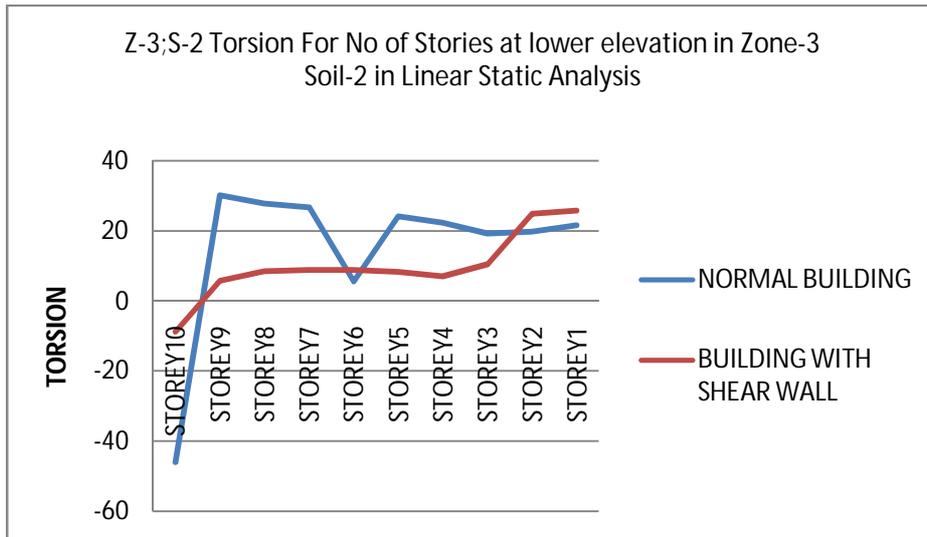
Storey	Normal Building	Building With Shear wall
Storey 9	0.51	2.37
Storey 8	0.19	0.67
Storey 7	0.25	0.86
Storey 6	0.24	0.82
Storey 5	0.23	0.77
Storey 4	0.22	0.69
Storey 3	0.2	0.59
Storey 2	0.18	0.52
Storey 1	0.1	0.25
Base	0.9	0.61

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Vol. 7, Issue 6, June 2018



Graph 4.4 : Showing Variation of Torsion of A Building in Zone-3 & Soil-2 At Lower Elevation In Linear Static Analysis

Table 4.5 : Comparative Values of Torsion of A Building in Zone 3 & Soil 3 At Higher Elevation in Linear Static Analysis

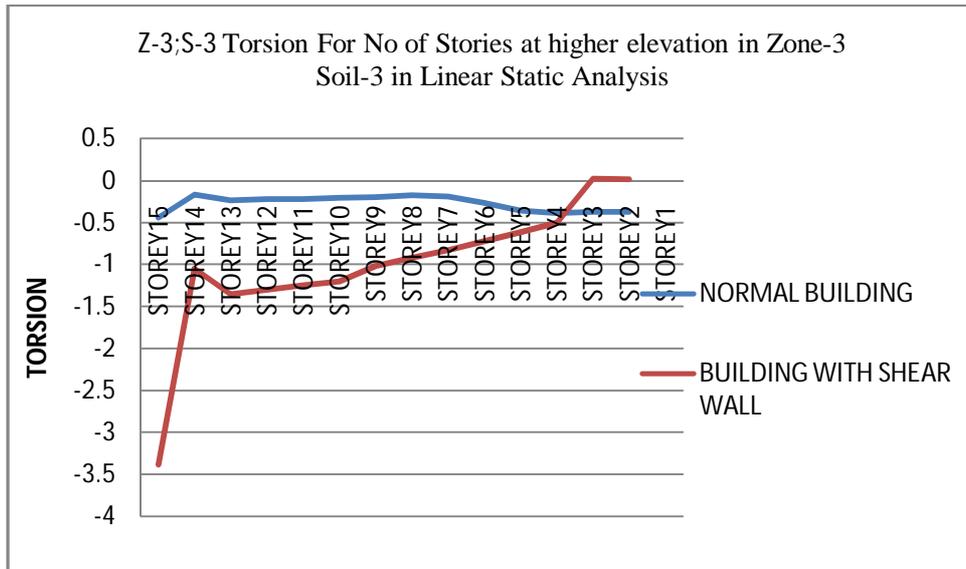
Storey	Normal Building	Building With Shear wall
Storey 14	-0.44	-3.38
Storey 13	-0.17	-1.05
Storey 12	-0.24	-1.35
Storey 11	-0.22	-1.3
Storey 10	-0.22	-1.25
Storey 9	-0.21	-1.2
Storey 8	-0.2	-1.02
Storey 7	-0.18	-0.92
Storey 6	-0.19	-0.83
Storey 5	-0.27	-0.72
Storey 4	-0.36	-0.62
Storey 3	-0.39	-0.5
Storey 2	-0.37	0.02
Storey 1	-0.37	0.01
Base	0	0

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Vol. 7, Issue 6, June 2018



Graph 4.5 : Showing Variation of Torsion of A Building in Zone-3 & Soil-3 At Higher Elevation In Linear Static Analysis

Table 4.6 : Comparative Values of Torsion of A Building in Zone 3 & Soil 3 At Lower Elevation in Linear Static Analysis

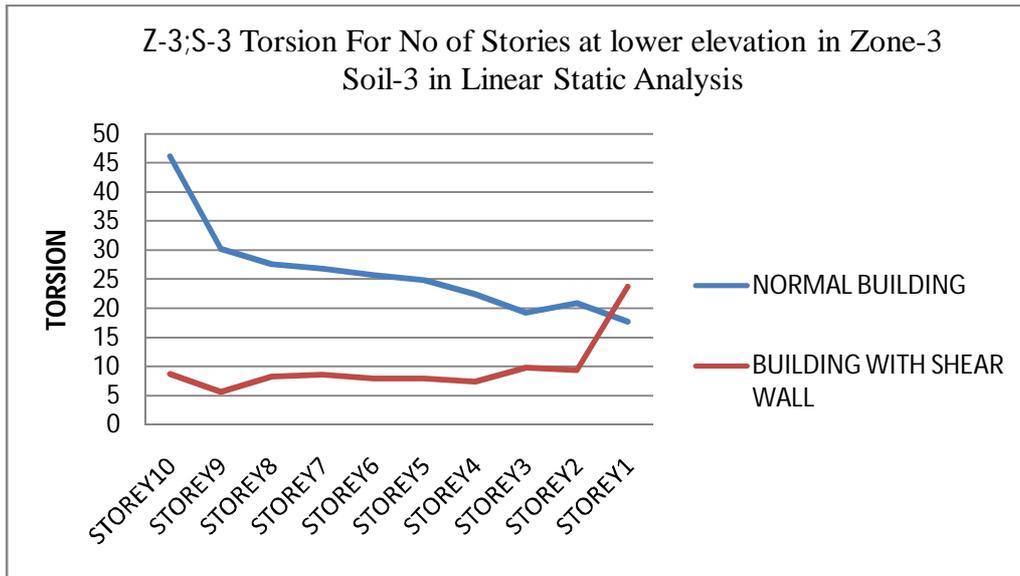
Storey	Normal Building	Building With Shear wall
Storey 9	0.51	2.42
Storey 8	0.19	0.68
Storey 7	0.25	0.86
Storey 6	0.24	0.81
Storey 5	0.23	0.76
Storey 4	0.22	0.68
Storey 3	0.200.18	0.58
Storey 2	0.08	0.5
Storey 1	1.09	0.23
Base	0	0

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(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 6, June 2018



Graph 4.6 : Showing Variation of Torsion of A Building in Zone-3 & Soil-3 At Lower Elevation In Linear Static Analysis

Table 4.7 : Comparative Values of Torsion of A Building in Zone 5 & Soil 1 At Higher Elevation in Linear Static Analysis

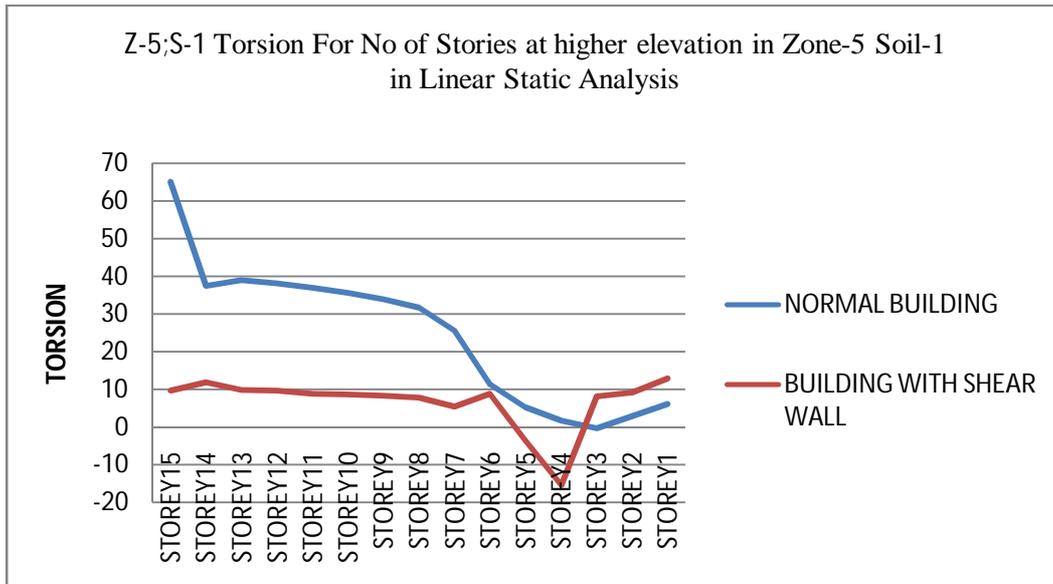
Storey	Normal Building	Building With Shear wall
Storey 14	-0.45	-3.31
Storey 13	-0.18	-1.01
Storey 12	-0.24	-1.32
Storey 11	-0.23	-1.28
Storey 10	-0.22	-1.25
Storey 9	-0.22	-1.18
Storey 8	-0.2	-1.11
Storey 7	-0.19	-1.01
Storey 6	-0.22	-0.91
Storey 5	-0.32	-0.81
Storey 4	-0.46	-0.69
Storey 3	-0.51	-0.5
Storey 2	-0.48	-0.48
Storey 1	-0.1	0.02
Base	0	0

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Vol. 7, Issue 6, June 2018



Graph 4.7 : Showing Variation of Torsion of A Building in Zone-5 & Soil-1 At Higher Elevation In Linear Static Analysis

Table 4.8 : Comparative Values of Torsion of A Building in Zone 5 & Soil 1 At Lower Elevation in Linear Static Analysis

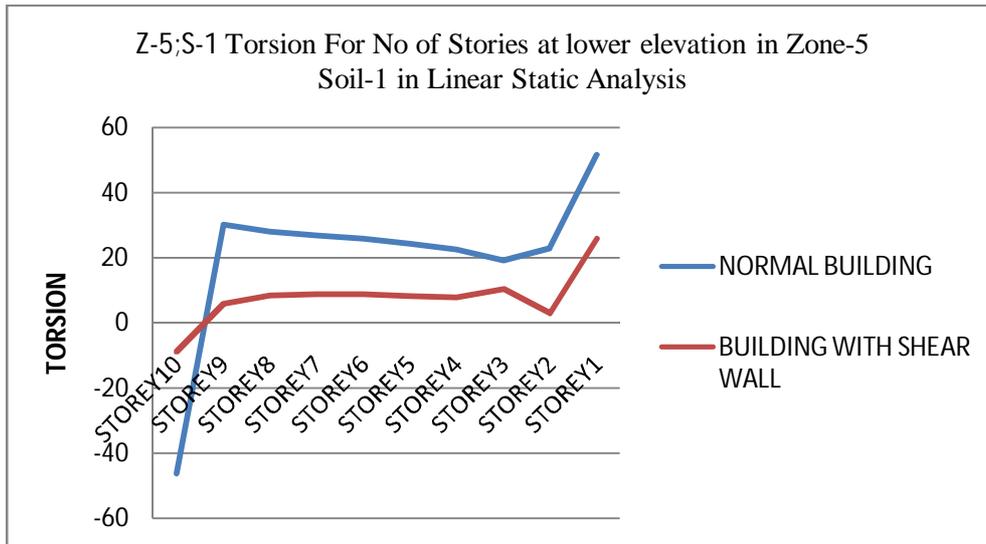
Storey	Normal Building	Building With Shear wall
Storey 9	0.51	2.37
Storey 8	0.19	0.67
Storey 7	0.25	0.86
Storey 6	0.24	0.82
Storey 5	0.23	0.77
Storey 4	0.22	0.69
Storey 3	0.2	0.99
Storey 2	0.18	0.52
Storey 1	0.06	0.26
Base	1.43	0.61

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Vol. 7, Issue 6, June 2018



Graph 4.8: Showing Variation of Torsion of A Building in Zone-5 & Soil-1 At lower Elevation In Linear Static Analysis

Table 4.9 : Comparative Values of Torsion of A Building in Zone 5 & Soil 2 At Higher Elevation in Linear Static Analysis

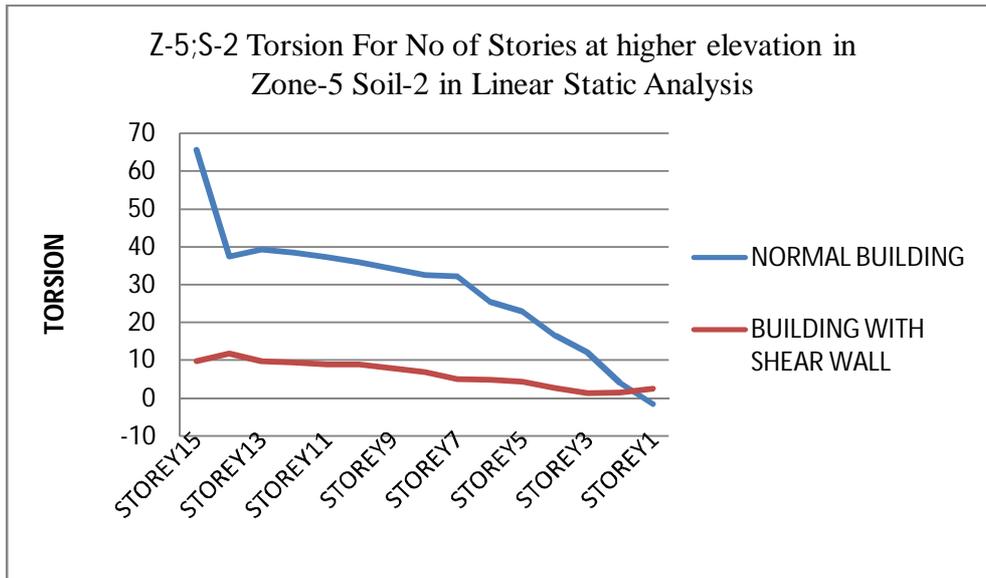
Storey	Normal Building	Building With Shear wall
Storey 14	0.41	-3.43
Storey 13	0.15	-1.07
Storey 12	0.21	-1.36
Storey 11	0.19	-1.31
Storey 10	0.18	-1.28
Storey 9	0.16	-1.21
Storey 8	0.14	-1.13
Storey 7	0.12	-1.03
Storey 6	0.06	-0.92
Storey 5	-0.07	-0.84
Storey 4	-0.23	-0.74
Storey 3	-0.32	-0.54
Storey 2	-0.34	-0.52
Storey 1	-0.13	0.01
Base	0	0

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Vol. 7, Issue 6, June 2018



Graph 4.9 : Showing Variation of Torsion of A Building in Zone-5 & Soil-2 At Higher Elevation In Linear Static Analysis

Table 4.10 : Comparative Values of Torsion of A Building in Zone 5 & Soil 2 At Lower Elevation in Linear Static Analysis

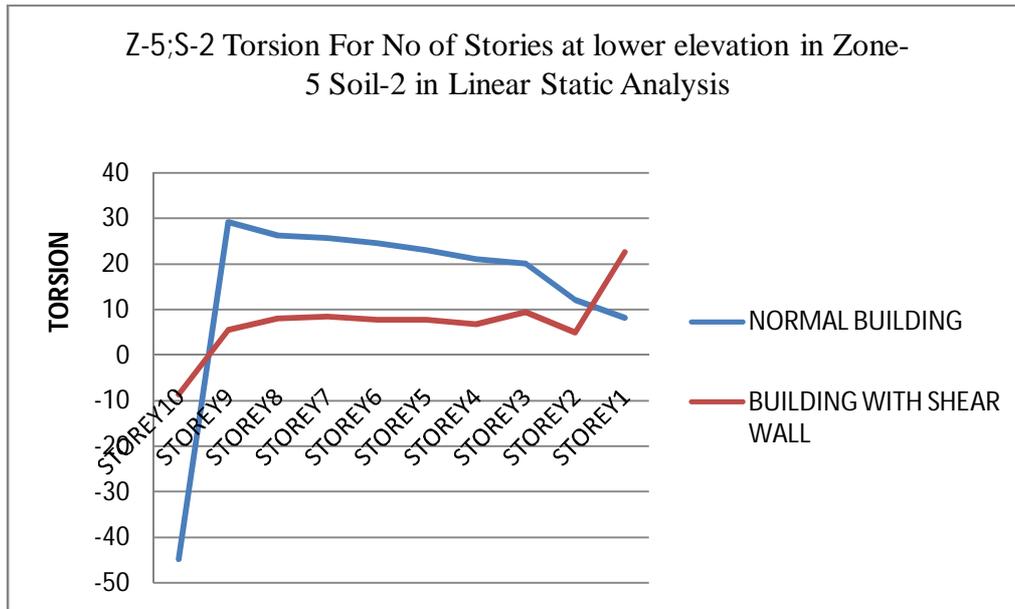
Storey	Normal Building	Building With Shear wall
Storey 9	-0.53	2.45
Storey 8	-0.23	0.69
Storey 7	-0.26	0.86
Storey 6	-0.24	0.81
Storey 5	-0.22	0.76
Storey 4	-0.21	0.68
Storey 3	-0.19	0.57
Storey 2	-0.18	0.49
Storey 1	-0.25	0.21
Base	1	0.64

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Vol. 7, Issue 6, June 2018



Graph 4.10 : Showing Variation of Torsion of A Building in Zone-5 & Soil-2 At lower Elevation In Linear Static Analysis

Table 4.11 : Comparative Values of Torsion of A Building in Zone 5 & Soil 3 At Higher Elevation in Linear Static Analysis

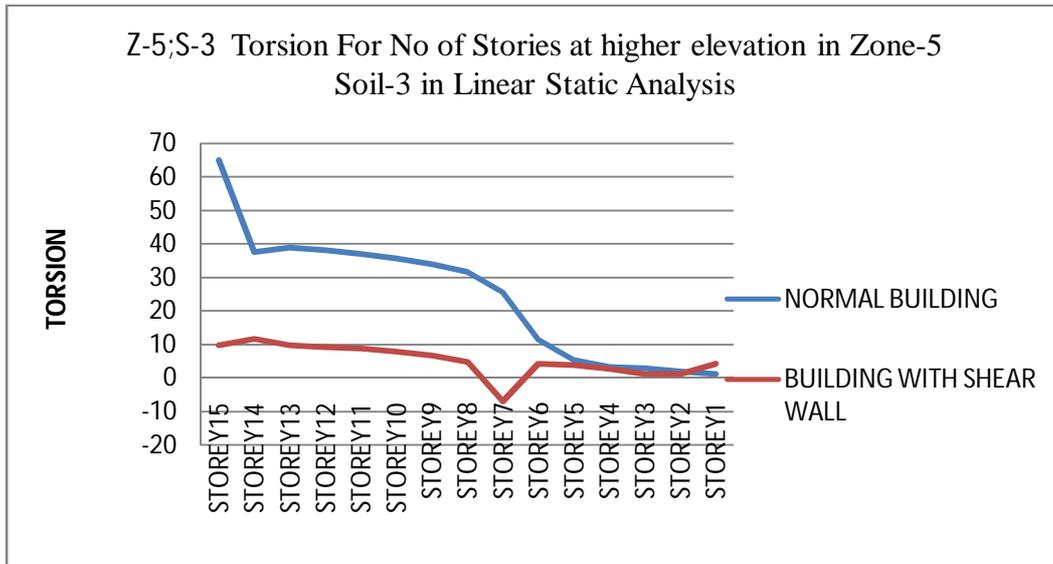
Storey	Normal Building	Building With Shear wall
Storey 14	-0.45	-3.53
Storey 13	-0.18	-1.11
Storey 12	-0.24	-1.39
Storey 11	-0.23	-1.34
Storey 10	-0.22	-1.31
Storey 9	-0.22	-1.24
Storey 8	-0.2	-1.15
Storey 7	-0.19	-1.05
Storey 6	-0.22	-0.94
Storey 5	-0.32	-0.86
Storey 4	-0.46	-0.77
Storey 3	-0.51	-0.57
Storey 2	-0.48	-0.27
Storey 1	-0.1	-0.22
Base	0	0

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Vol. 7, Issue 6, June 2018



Graph 4.11 : Showing Variation of Torsion of A Building in Zone-5 & Soil-3 At Higher Elevation In Linear Static Analysis

Table 4.12 : Comparative Values of Torsion of A Building in Zone 5 & Soil 3 At Lower Elevation in Linear Static Analysis

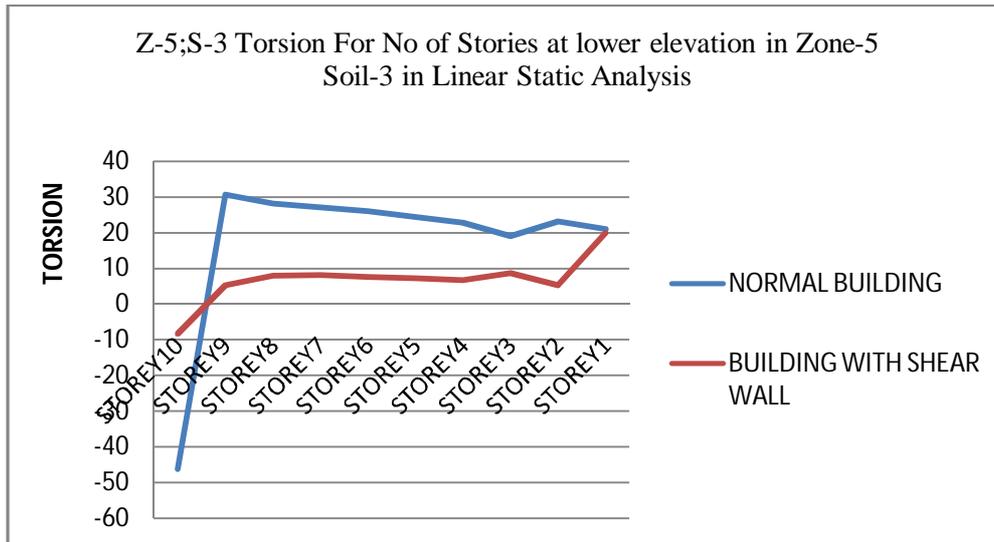
Storey	Normal Building	Building With Shear wall
Storey 9	0.51	2.52
Storey 8	0.19	0.7
Storey 7	0.25	0.86
Storey 6	0.24	0.81
Storey 5	0.23	0.75
Storey 4	0.22	0.67
Storey 3	0.2	0.55
Storey 2	0.18	0.47
Storey 1	0.06	0.17
Base	1.44	0.67

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Vol. 7, Issue 6, June 2018



Graph 4.12: Showing Variation of Torsion of A Building in Zone-5 & Soil-3 At Lower Elevation In Linear Static Analysis

IV. CONCLUSION

Sloped ground is analysed in linear static analysis for torsion in higher elevation and lowest elevation of the sloped building, from the analysis it is noted that torsion was decreased when the shear walls are provided on optimum locations. Stiffness of the structure is also increased when the shear walls are provided.

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