International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 01 | Jan 2021 www.irjet.net p-ISSN: 2395-0072

Seismic Behavior of Steel Building Frame with without Bracing System

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Abstract - *This research paper consists on "seismic Analysis of steel Building framed structure with bracing system, with two different XVX and VXV bracing system. The building configuration of 18m x 18m along to X and Z direction respectively with floor height of 3.5m is taken. In this work, the proposed building frame structure with various input parameter such as G+16 multi-storey frame, Size of Column = ISWB250, beam = ISWB250 ,Bracing= ISLB150, Height of each floor = 3.5m and total height of building 59.50m, symmetrical in plan 18m x 18m but unsymmetrical in ways due to 5m, 6m, 7m along to X and Z direction of way, Types of Bracing= reversed V and X, Seismic Parameter: according to IS 1893-2002 , Seismic Zone-II, Medium and Soft Soil ,Damping = 5% (according to table-3 statement 6.4.2), Zone factor for zone II, Z=0.10, I=1.5 (Important structure according to Table-6) , R=5 Steel moment resisting frame designed as per SP 6 (6) (Table-7) and various load like wall load 15.46 KN/m, live load 3.5 KN/m2, floor finish load 0.75 KN/m2etc. Density of RCC: 25.kN/m3 and masonry: 20.kN/m3 is taken. The results compared in the term of displacement, Axial force, bending moment and storey wise displacement.*

Key Words: STAAD.PRO, storey displacement, max bending moment, structural analysis, seismic analysis.

1. INTRODUCTION

Tremor is a characteristic marvel, which is produced in earth's hull. Length of seismic tremor is normally rather short, enduring from few moments to over a moment or thereabouts. In any case, a great many individuals lose their carries on with because of tremors in various pieces of the world. Building breakdown or harms are the significant misfortune because of seismic tremor ground movement. Horizontal soundness has consistently been a significant issue of structures particularly in the zones with high seismic tremor risk this issue has been contemplated and concentric, unconventional and knee propping frameworks have been recommended and thusly utilized by structural architects. The propping framework that has a more plastic disfigurement before breakdown can retain more vitality during the seismic tremor. The main role of a wide range of basic frameworks utilized in the structure kind of structures is to move gravity stacks successfully. The most well-known burdens coming about because of the impact of gravity are dead burden, live burden and snow load. Other than these vertical burdens, structures are likewise exposed to horizontal burdens brought about by wind, impacting or quake. Parallel burdens can grow high anxieties, produce influence development or cause vibration. Thusly, it is significant for the structure to have adequate quality against vertical loads along with sufficient firmness to oppose parallel powers. Propping is a profoundly productive and conservative technique to along the side solidify the casing structures against tremor and wind loads. A propped bowed comprises of regular segments and braces whose main role is to help the gravity stacking, and corner to corner supporting individuals that are associated so all out arrangement of individuals frames a vertical cantilever bracket to oppose the even powers. Supporting is effective on the grounds that the diagonals work in hub stress and along these lines call for least part estimates in giving the solidness and quality against level shear.

For the most part, the utilization of bracings rather than Shear dividers gives lower solidness and protection from a structure yet it ought not be overlooked that such a framework has lower weight and more valuable for engineering purposes. Utilization of supports for seismic recovery of structures ought not cause any twist issue and architects ought to know about expanding the hub heaps of sections in propping boards. The best and handy strategy for upgrading the seismic obstruction is to build the vitality retention limit of structures by consolidating supporting components in the casing. The supported edge can ingest a more prominent level of vitality applied by tremors. In propped outline decreases the section and brace twisting minutes. Propping individuals are broadly utilized in steel structures to lessen horizontal removals and disperse vitality during solid ground movements. The supports are typically positioned in vertically adjusted ranges. This framework permits acquiring an incredible increment of solidness with an insignificant included weight, thus it is exceptionally successful for existing structure for which the helpless horizontal firmness is the primary issue. The concentric bracings increment the parallel solidness of the edge, in this manner expanding the regular recurrence and furthermore generally diminishing the horizontal float. Be that as it may, increment in the firmness may draw in a bigger idleness power because of tremor. Further, while the bracings decline the twisting minutes and shear powers in sections, they increment the hub pressure in the segments to which they are associated.

1.1 Problem Definition

The auxiliary displaying and examination is finished utilizing STAAD-PRO programming bundle to oppose seismic burden. Examination is done for G+ 16 celebrated steel structures. Three sorts of casings were dissected in particular exposed casing, XVX propping casing and VXV supporting edge. Normal unbending steel outline structure with and without propping framework containing three diverse model of comparable arrangement are exposed to seismic burden as indicated by zone II and III. A run of the mill plan is appeared in figure 1.1. Situated on a Soft soil and medium soil layers are picked for the examination. Equal static examination is performed on the models of the structure considered in this investigation. Bracings are given at the diverse situation of the structure. Section sizes and propping sizes are same for all individual from the structure outline structure. In this examination the heap blends will be accounted according to I.S 1893 (Part I)- 2002.

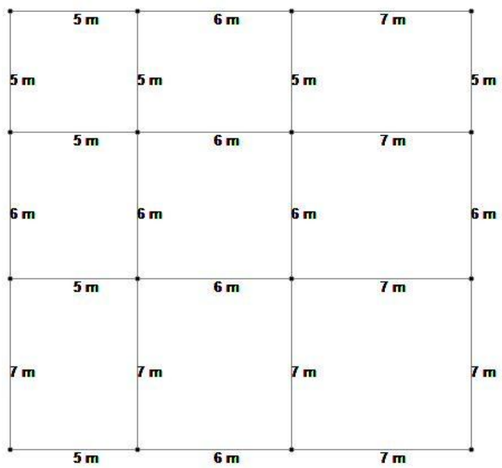

Fig. 1.1 Plan

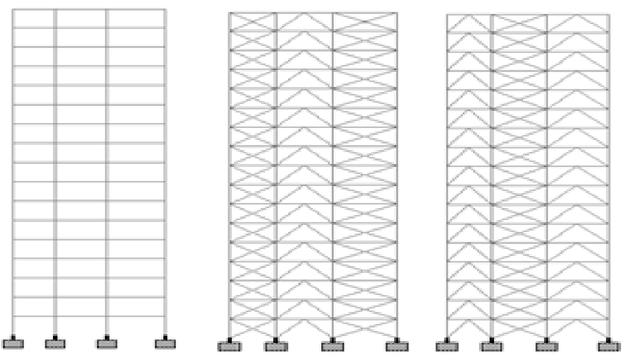

Fig. 1.2 with & without Bracing

1.2 Objectives of work:

- To determine the effect of different seismic zones.
- To determine the impact due to bracing System on Steel building frame structure.
- To find out the variation due to different types of soil considered

2. REVIEW OF SURVEY

1. Ajay Mapari, Prof. Y. M. Ghughal (2017):- He investigated the 25 story steel building outline without and with various sort of supporting framework, for example, K, V, rearranged V, X type propping framework. He dissected the structure by business bundle of Etabs2013 programming and by utilizing reaction range technique according to Indian Code. He considered the diverse boundary, for example, seismic zone IV with medium soil condition, significance factor 1, and damping proportion five percent. He saw that, because of horizontal solidness, expanded the base shear in supporting framework and for various propping framework, changes in base shear, uprooting and model timeframe with various example of propping framework contrasted and without propping arrangement of the encircled structure.

2. Karthik, Sridhar R etc al- He considered that seismic examination of steel building encircled structure of G+15 story with various sort of supporting like as V, X, K, k, chevron propping and flighty corner to corner and Knee supporting moreover. The investigation was finished by proportional static technique, reaction range strategy and direct static history technique for Bhuj city seismic zone V. The structure was ordinary supported structure analyzed and he contemplated the best propped structure to oppose the parallel burdens. He saw that in every one of the three technique, the ordinary baced model, X propping and chevron supporting framework best impervious to seismic tremor stacks then other indicated diverse supporting framework.

3. Safvana P and Anila S (2018):- He separated the Steel structure with and without supporting system and RCC structure under the seismic weights by using Etabs programming. He considered different sort supporting system like X propping, zipper supporting, etc. The propping is given at each side of different multistory structure like G+6, G+12, G+18 story with 6x3 bays along to X and Y bearing and played out that the reasonability of various sort supporting system in steel and RCC structures. He saw that the rate decline in sidelong expulsion and mutilation and base shear is less for SBS with twofold spring propping system by virtue of RCC structure and for steel structures distortion is less for zipper supporting structure and base shear regard is in like manner less for SBS with twofold spring propping system.

3. METHODOLOGY

This exploration work, comparable examination of Seismic tremor lead on high rise structures G+16. Building diagram with two unmistakable soil types and differing supporting structure. Under the Seismic tremor sway as indicated by IS 1893(part I) - 2002 static examination. An assessment of examination realizes terms of most outrageous evacuations; Greatest bowing second, most extraordinary Story Dislodging, Greatest shear power has been finished.

This study is attempted in following steps:

In this work, the seismic analysis of steel framed structures is done by the following steps of the methodology. The proposed methodology is as follows:

1) An extensive survey of the literature on the response of steel structures to seismic loading is performed.

2) Different type of steel structure are taken and analyzed by static linear and static nonlinear analysis.

3) Different type of bracing system of steel structures are taken and analyzed by different ground motion with the help of time history analysis.

4) Calculate the total steel consumption in three different types of steel structure i.e. without bracing, inverted V-bracing and X-bracing.

5) Plot different curves from linear static analysis for three different types of steel structure i.e. without bracing, inverted V-bracing and X-bracing.

3.1 PROBLEM DISCRIPTION

Table .1:- Structural Modeling Specification of 17 storey Buildings

S. No	Type of Structure	Without Bracing	Inverted V type Bracing	X type Bracing	Remarks
1.	Bay width along longitudinal direction of the structure	18	18	18	meter
2.	Bay width along Transvers direction of the structure	18	18	18	meter
3.	Total Height of the structure	59.5	59.5	59.5	meter
4.	Live Load on the structure	3.5	3.5	3.5	KN/m²
5.	Floor Finish on the structure	0.75	0.75	0.75	KN/m²
6.	Wall Load on the structure	15.46	15.46	15.46	KN/m
7.	Type of Concrete in the structure	M-25	M-25	M-25	F_{ck} =25 N/mm²
8.	Type of Steel on the structure	Fe-415	Fe-415	Fe-415	F_y=415 N/mm²
9.	Each Column Height of the structure	3.5	3.5	3.5	meter
10.	Support Condition of the structure	Fixed	Fixed	Fixed	All Fixed

Table- 2: Load Combination

Load Combination	
Case No.	**Load Combination**
1	D-L
2	L-L
3	EQ_X
4	E.Q._Z
5	1.7(D-L+L-L)
6	1.7(D-L+E.Q._X)
7	1.7(D-L-E.Q._X)
8	1.7(D-L+E.Q._Z)
9	1.7 (D.L-E.Q._Z)
10	1.3(D.L+L.L+E.Q._X)
11	1.3 (D.L+L.L-E.Q._X)
12	1.3 (D.L+L.L+E.Q._Z)
13	1.3 (D.L+L.L-E.Q._Z)

4. RESULT AND ANALYSIS

4.1 BENDING MOMENT

Soil Type	Maximum Bending Moment (KN-m)		
	ZONE-II		
	Without Bracing Model	With XVX Bracing Model	With VXV Bracing Model
Soft	362.714	234.451	183.831
Medium	362.714	234.451	183.831

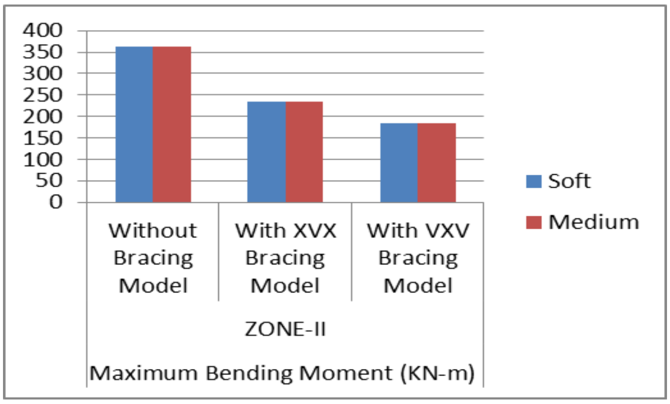

Fig. 4.1 Bending Moment

4.2 AXIAL FORCE

Soil Type	Maximum Axial Force (KN)		
	ZONE-II		
	Without Bracing Model	With XVX Bracing Model	With VXV Bracing Model
Soft	12515.368	7846.997	7888.919
Medium	12514.368	7846.997	7888.919

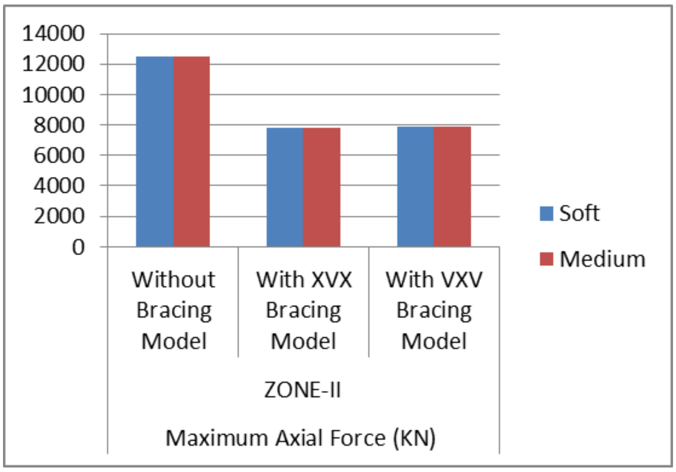

Fig. 42 Axial Force

4.3 STOREY DISPLACEMENT

STORY	Story Wise Displacement in X direction					
	Without Bracing Model		With XVX Bracing Model		With VXV Bracing Mode	
	Soft Soil	Medium Soil	Soft Soil	Medium Soil	Soft Soil	Medium Soil
Base	0	0	0	0	0	0
GF	8.77	7.153	1.56	1.34	1.471	1.242
1st Storey	22.597	18.468	3.895	3.351	3.687	3.119
2nd Storey	38.113	31.328	7.169	6.209	6.712	5.712
3rd Storey	54.564	45.087	11.286	9.83	10.519	8.993
4th Storey	71.752	59.58	16.17	14.145	15.043	12.916
5th Storey	89.52	74.664	21.741	19.083	20.192	17.396
6th Storey	107.705	90.198	27.92	24.607	25.893	22.369
7th Storey	126.135	106.03	34.649	30.816	32.076	27.775
8th Storey	144.62	121.996	41.883	37.539	38.667	33.55
9th Storey	162.961	137.923	49.509	44.687	45.594	39.631
10th Storey	180.941	153.627	57.451	52.184	52.785	45.956
11th Storey	198.333	168.912	65.637	59.967	60.17	54.462
12th Storey	214.893	183.57	74.227	67.97	67.679	59.089
13th Storey	230.371	197.388	83.03	76.133	75.25	65.783
14th Storey	244.481	210.123	91.92	84.392	82.818	72.487
15th Storey	256.997	221.587	100.843	92.696	90.32	79.144
16th Storey	267.096	230.978	109.729	100.98	97.718	85.722

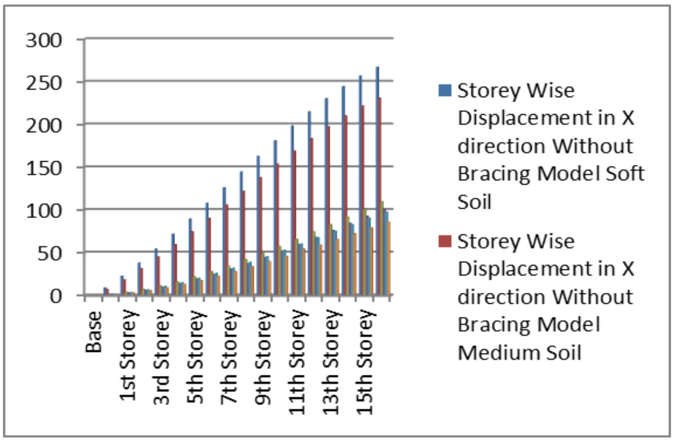

Fig. 4.3a: Story wise Displacement

STORY	Story Wise Displacement in Z direction					
	Without Bracing Model		With XVX Bracing Model		With VXV Bracing Mode	
	Soft Soil	Medium Soil	Soft Soil	Medium Soil	Soft Soil	Medium Soil
Base	0	0	0	0	0	0
GF	21.085	17.422	1.563	1.339	1.415	1.199
1st Storey	46.254	38.328	3.898	3.348	3.638	3.103
2nd Storey	70.715	58.399	7.16	6.194	6.76	5.802
3rd Storey	94.487	77.978	11.269	9.805	10.729	9.263
4th Storey	117.5	96.718	16.143	14.109	15.44	13.388
5th Storey	139.681	114.667	21.703	19.036	20.813	18.106
6th Storey	160.924	131.75	27.913	24.563	26.773	23.352
7th Storey	181.104	147.873	34.668	30.792	33.245	29.059
8th Storey	200.157	163.011	41.889	37.504	40.152	35.161
9th Storey	222.796	181.918	49.501	44.632	47.421	41.789
10th Storey	244.548	200.177	57.428	52.109	54.98	48.727
11th Storey	265.088	217.493	65.599	59.871	62.758	55.91
12th Storey	284.066	233.592	74.118	67.853	70.686	63.277
13th Storey	301.106	248.153	82.899	75.994	78.7	70.771
14th Storey	315.808	260.841	91.769	84.233	86.736	78.335
15th Storey	327.806	271.359	100.665	92.512	94.739	85.92
16th Storey	335.73	278.404	109.527	100.773	102.678	93.505

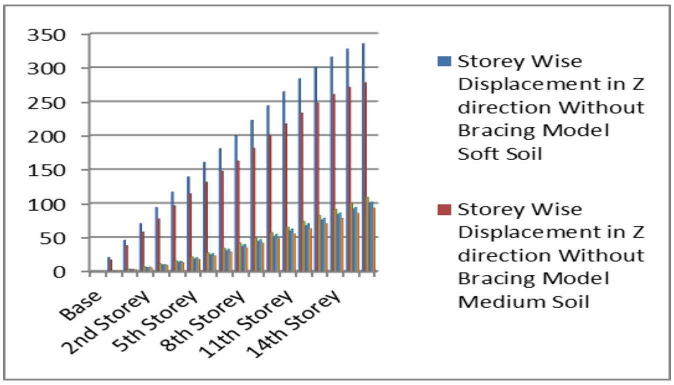

Fig. 4.3b: Story wise Displacement

5. CONCLUSIONS

Maximum bending moment

- Maximum bowing second is resolved in without propped outline, normal is XVX supported casing and least in VXV supported casing subsequently VXV supported casing is nearly increasingly steady.

Maximum axial force

- Maximum pivotal power is resolved in delicate soft soil and least in medium soil, along these lines medium soil is relatively increasingly steady.
- Maximum axial force found in without braced model while average in with VXV model and minimum in with XVX model.
- As contrasting various planes, at the most pivotal power is determined without propped outline when contrasted with supported casing while hub power are same in both propped outline structure.

Maximum storey displacement

- Maximum sotery displacement is found in top storey while minimum in bottom sotorey of the structure. It means the storey displacement increased with increasing the storey heights.
- Maximum storey displacement is observed in without bracing model, average in XVX model and minimum in VXV model with soft and medium soil respectively.

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BIOGRAPHIES

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