Comparative Study of Tall Structure with and Without X- Bracings and Shear Links of Different Material

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Abstract— As Population of India is rapidly increasing, there is a high requirement of more shelters to settle down this population thus there is a high demand of tall structure. Tall structure s are generally came in contact with lateral forces due to (wind & seismic) intensities are high, which may causes failure of structure therefore to counteract these vast lateral forces we need some special techniques in such tall structure. in this study we will apply some extra innovative technique to stable the structure by providing bracings and shear links in the structure and prepare a comparison between bare frame, frame with bracings and shear links with two different type of material such as steel and Aluminium for this comparative study we have consider a symmetrical plan of G+12 floors considering Seismic zones IV & medium type soil as per I.S. 1893 part 1 2002. for analyzing and modeling purpose staad.pro programming is utilized and study is done on the premise of maximum storey displacement, axial forces, shear forces, maximum bending, storey drift, stiffness and displacement in x and z direction. In this study we have adopted 13 loading combination in each case as per Indian standards and Dimensions of column and beam in all the cases were same. We observed the result of all the cases in the manner, bare frame shows maximum values in all parameters, steel bracing frame shows moderate result and frame with Aluminium bracing with shear links shows minimum.

Key words: Structural Analysis, Axial Force, Soil, Seismic Zone, Shear Links. Bracings

I. Introduction

Tall building improvement includes different complex factors, for example, financial matters, style look, innovation, civil directions, and legislative issues. Among these, financial matters has been the essential administering factor. For an extremely tall building, its auxiliary plan is by and large administered by its parallel solidness. Contrasting and traditional orthogonal structures for tall structures, for example, encircled tubes, vertical shear connect improved structures convey parallel seismic loads substantially more productively by their corner to corner part's pivotal activity. A shear interface structure gives incredible basic productivity to limit stretch convergence of a structure with bracings. A shear interface structure is a sort of auxiliary framework comprising of bracings associated through even rings which make an exquisite and excess structure that is particularly productive for elevated structures. A vertical shear connect structure is unique in relation to supported casing frameworks, since shear board is vertically introduced at joints of propping as fundamental basic components take an interest in conveying gravity stack notwithstanding conveying horizontal load because of their design.

Some of the background study done in past are:

A. Vishwanath B. Patil (2016)

Studied on stability analysis of multistory building with underneath satellite bus stop having Service soft storey and floating columns. In this investigation, the study of analysis of columns, shear walls, coupled component, single and multistory structure was done. For the stability of the building, arrangements like bracing system and shear system is provided or combination of both was used.

B. Akshay Sonawane et. al. (2016)

Focuses on the effect of bracing system on the storey that is critical in the structure. They studied on bracing systems like cross bracing, diagonal bracing, inverted V bracing and V bracing systems and results on components like storey drift and bending moment in columns and storey displacement were calculated.

C. Anuj K. Chandiwala et. al. (2014)

Studied on seismic response of RC building with soft stories. The strong column and weak beam construction is done for the safety of building during earthquake. Because of this concept, beams yield before columns collapse. In this research, different models are analysed with soft storey for proper assessment of the stiffness of the storey. They concluded that displacement would be more at upper stories and less at lower stories.

D. Raut Harshalata et. al. (2014)

Studied the effect of steel plate shear wall on behaviour of structure. In this paper, design and analysis of steel building is done with and without steel plate shear wall. G+6 storey building for seismic zone III is studied and static analysis is done using STAAD Pro software. The main components which were fond out for the seismic performance are bending moment, shear force, deflection and axial force and comparison is done. The effect of shear wall is also considered.

1) Objective of Our Study:

- Determination of the effect of bracing with shear link on the resistivity of lateral forces.
- Determination of effect of shear link bracing of steel and aluminium material on lateral forces.

II. Problem Statement

Here we have selected five cases for comparison
First one is bare frame, Second is frame with bracing of steel at the corners, Third one is frame with bracings of steel and shear links, Fourth one is bracings of aluminum at the corners, Fifth one is bracings of aluminum and shear links
The building configuration selected is a representative of building that is common in Indian seismic Zones IV as per IS: 1893-2002 (Part-1) located in medium soil region in seismic zone IV. The building is found to be deficient of the lateral

seismic load corresponding to that of particular earthquake zone. Hence, it needs to be strengthened by providing aluminum and steel bracing with or without shear links; assumed value for this problem is shown in table 1.

S no.	Description of assumed parameters	value
1	Seismic zone	IV
2	Soil type Medium	medium
3	Importance factor	1
4	Response reduction factor	3
5	Number of storey	12
6	Grade of concrete	M-20
7	Grade of steel	Fe-415
8	Slab thickness	150mm
9	Exterior wall thickness	230mm
10	Interior wall thickness 120 mm	120mm
11	Bay width in X direction	3 m
12	Bay width in Z direction	5 m
13	Size of beam	230 x 400 mm
14	Size of column	400 x 400 mm
15	Storey height	3.5

Table 1: Parameters

Selection of building geometry rectangular shape (12 X 15 m) G+12 storey of 3-D frame as shown in Figure. 2 has been selected.

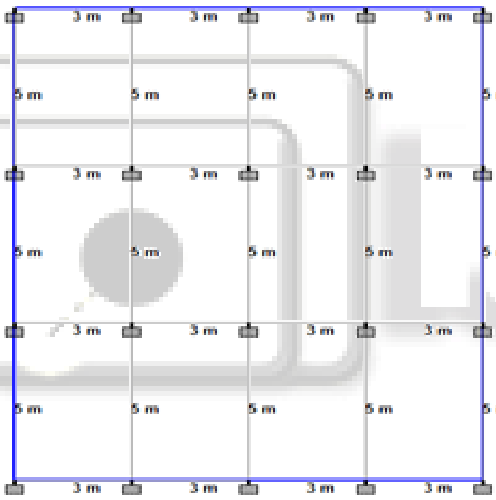

Fig. 1

III. METHODOLOGY

- Modelling the structure in staad pro v8i.
- Allocation of properties to all the section.
- Creation of bracings with shear links for all the cases

a) Steel
b) Aluminium

- Applying seismic loads, dead load, live load as per I.S. Standards.

Seismic Zone	II	III	IV	V
Intensity	Low	moderate	Severe	Very Severe
Z	0.1	0.16	0.24	0.36

- Apply load combination as per 875 partV.
- Analysis and design of the structure.

IV. RESULTS AND DISCUSSION

A. *Maximum Bending Moment in Z direction*

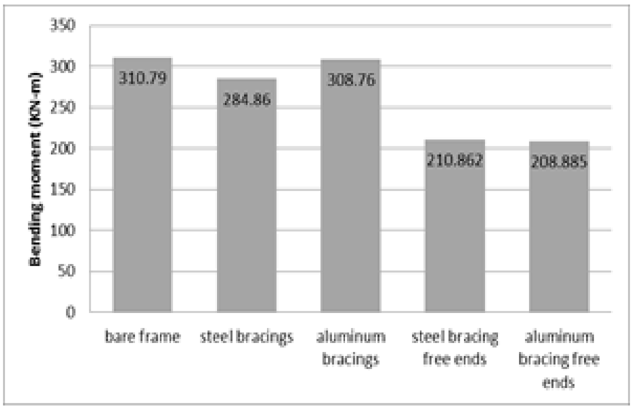

Fig. 2

Bending Moment maximum is shown in bare frame as compared to other structures which means reinforcement requirement is higher in bare frame.

B. *Maximum Bending Moment in Y Direction*

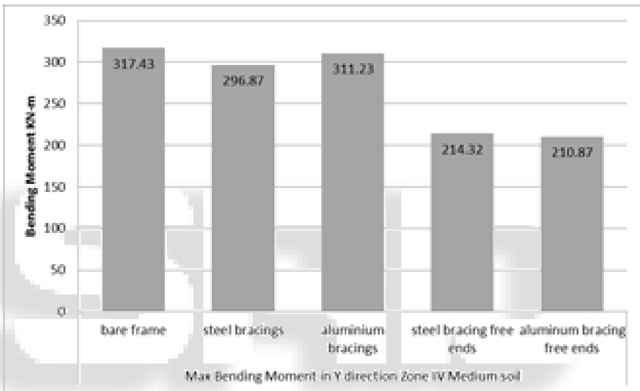

Fig. 3

Aluminum bracings with free ends shows more precise value as compared to steel bracing with free ends which shows that use of aluminium can be more effective to resist Beanding Moment.

C. *Axial Force in Due to EQ Load*

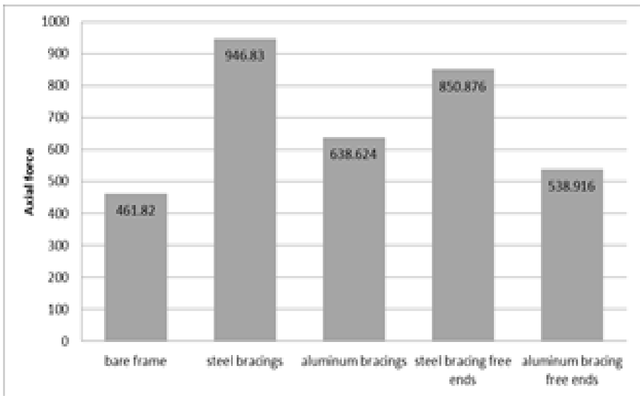

Fig. 4

In comparison of steel and aluminium bracing with free ends case results shows that aluminium case is showing lesser value which determines that it is more stable.

D. Shear Force

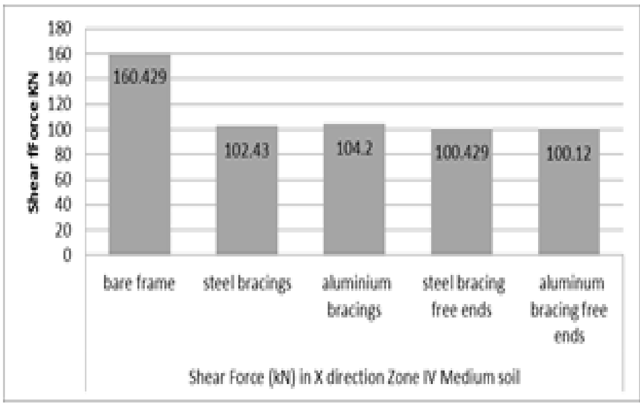

Fig. 5

In comparison of free end cases aluminum bracing system is proven more resistible to unbalances fore and will be more stable.

Here aluminium bracing with shear links are showing least shear force which means it has more resistive response as compared to other cases whereas bare frame case is worst in shear force and shear failure can be occur in this case.

E. Storey Drift

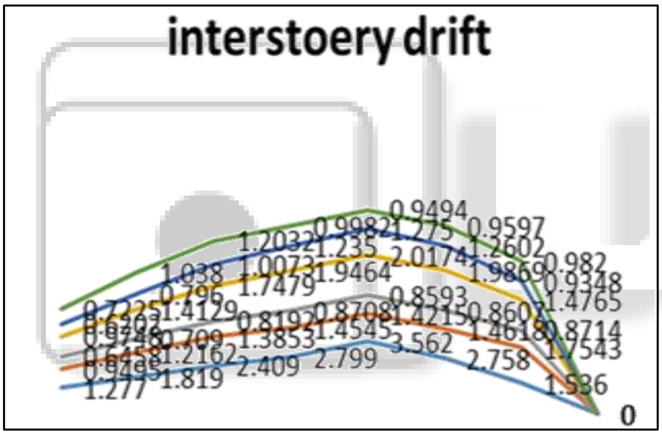

Fig. 6

In steel and aluminium bracing with free ends case results shows that steel structure is providing least value of drift but aluminium structure value is relatively same as steel bracing with free end case values.

F. Storey Stiffness

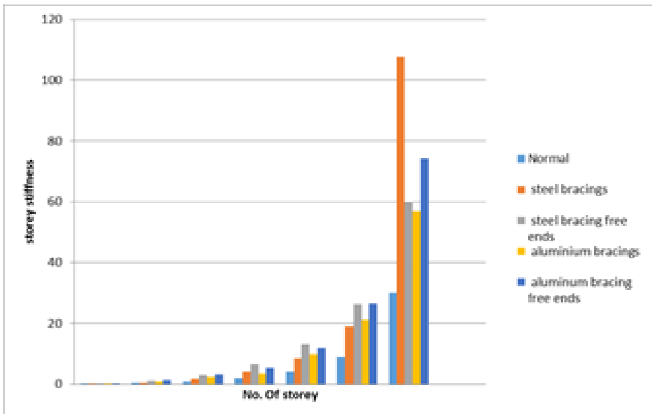

Fig. 7

Aluminum bracing with free ends shows greater value at base compare to steel bracing with free ends.

G. Storey Displacement

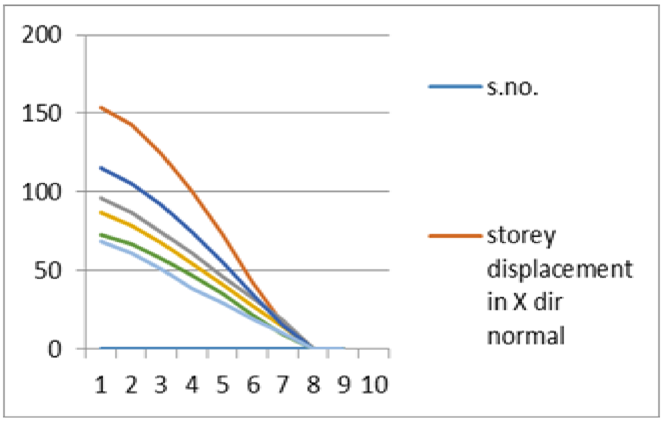

Fig. 8

Aluminum bracing with free ends show less displacement in x directional as compare to steel displacement.

V. CONCLUSION

From the present study it is seen that aluminium bracings is much efficient in comparison to simple frame and other cases as well in reducing moment, storey displacement, stiffness & drift whereas in case of axial force steel bracing system is more stable. Vertical shear links have fat and stable hysteresis loops.

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