Analysis of a Mid Rise 3dimensional Building Frame Considering Links at the Corner Bracing using Analysis Tool Staad.Pro

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Abstract— 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. 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. In this study we present cost analysis of tall structure with shear links to determine the cost effectiveness of the structure. And concluded that steel bracing frame will be economical and lateral load resistive.

Key words: Shear Links, Bracings, Structure Analysis, Tall Structure

I. INTRODUCTION

Vertical shear-links in characterstic bracing systems, not similar to one located in the structure and can be easily changed or modified therefore, after the seismic effects, considering that other frame elements will remain elastic, only the vertical shear-links should be change, and then frame structure can function normally. A X type bracing system is designed and fit with high accuracy and a small change in its characteristics reduce the ductility without increasing the stiffness, but unlike knee brace, vertical shear-link can be easily designed and implemented.

In this comparative study on the effect of vertical shear-links to determine its positive impact to enhance resistivity and comparing the variation in forces in bare frame, braced system with vertical shear links.

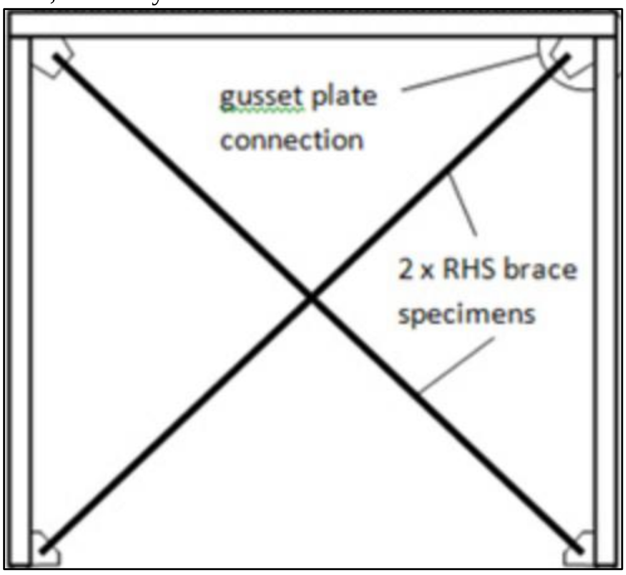

Fig. 1: X bracing with shear links

For this study they are considering a G+6 tall structure providing loadings as per Indian provisions and seismic zone IV with medium type soil as per I.S. 1893 part-1 for modelling and analysis, they are using analysis tool/software STAAD.Pro V8i. Five different cases conditions to compare and determine the best effective designing to resist forces has been created. Here we will compare cost of all the cases.

II. LITERATURE REVIEW

Tejas D. Joshi (2018) studied on bracing systems on high rise steel structures. For this investigation, G+15 storied steel frame structure models with same sections and different bracing arrangements like X bracing, double X bracing, Single diagonal, K bracing and V bracings are used. STAAD Pro V8i software is used for the seismic analysis and comparison is done with different parameters. The reduction in displacement is higher in case of V bracing and K bracing compared to un-braced building due to irregularity in shape of the building. Storey drifts may increase or decrease in braced building compared to un-braced building structure.

Zasiah Tafheem et. al. (2017) contemplated on basic conduct of steel working with concentric and capricious propping. Examination is done because of wind stack, quake stack, dead load and live load. Diverse supporting sorts, for example, concentric X propping and whimsical V sort bracings are utilized for the examination utilizing HSS areas. They reasoned that there is diminishment in sidelong uprooting when contrasted with un-propped fabricating. From this examination, they found that concentric X propping gives less sidelong removal when contrasted with unpredictable V sort supporting. In nearness of propping framework, the between story float lessening gets expanded. Because of increment in lever arm of peripherial corner to corner segments, diagrid auxiliary framework is more compelling in parallel load resistance. Horizontal and gravity stack are opposed by pivotal power in corner to corner individuals on fringe of structure, which make framework more compelling. Diagrid basic framework gives greater adaptability in arranging inside space and façade of the building.

D.K. paul et. al. (2012) presented a practical implementation on a earthquake resistance building to resist non linear (pushover) lateral seismic forces. Retrofitting is introduced in which chevron bracing and aluminium shear link as a beam is introduced to improve its performance and concluded that with the use of bracing and shear link building becomes more responsive and capable of bearing lateral forces.

Dipti r. Sahoo et. al. (2010) displayed an exploratory examination is led on a decreased scale non-pliable RC casing to research the adequacy of the fortifying framework under consistent gravity stacking and steadily expanding turned around cyclic sidelong relocations. The fortified example displayed improved parallel quality, solidness and vitality dispersal potential when contrasted with the RC (uncovered) outline. parallel load on the edge is permitted to exchange to the shear connect through a heap exchanging framework comprising of a shear authority shaft and chevron supports in order to cause shear yielding of aluminum plates. No broad fortifying of the current RC sections is completed in the proposed procedure. Reasoned that the vitality dissemination and damping capability of the shear interface fundamentally lessened the harm levels in the current RC individuals from the fortified example up to 3.5% float level.

A. The objectives of the study are as follows:

1) Determination of the effect of bracing with shear link on the performance of tall rise moment resisting frame structure.
2) Determination of effect of shear link bracing of steel and aluminium material on lateral forces.
3) Comparison of cost in all the cases to determine economical section.

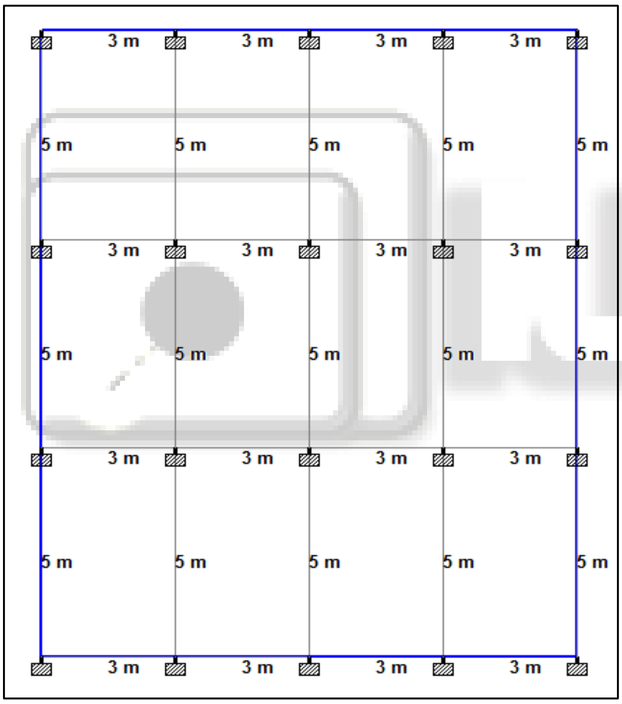

Fig. 2: planning of the structure

III. METHODOLOGY

1) Step-1 selection of building geometry rectangular shape.
2) Step-2 Modelling of selected geometry & property.
3) Step-3 Applying bracings and shear links.
4) Step-4 Selection of Seismic zones (Zone IV) and medium type soil as per IS- 1893(part I) -2002.
5) Step-5 Load combination:

S.No	Load cases
1	D-L
2	L-L
3	EQ-X
4	EQ-Z
5	EQ X –VE
6	EQ Z –VE
7	1.5(D-L+L-L)
8	1.5(D-L+EQ X)
9	1.5(D-L-EW X)
10	1.5(D.L+EQ_Z)
11	1.5(D.L-EQ_Z)
12	1.2(D.L+L.L+EQ_X)
13	1.2(D.L+L.L+EQ_X)
14	1.2(D.L+L.L+EQ_Z)
15	1.2(D.L+L.L-EQ_Z)

Table 1: Load combination

6) Step-6 Analysis of building frames considering seismic forces in X & Z direction

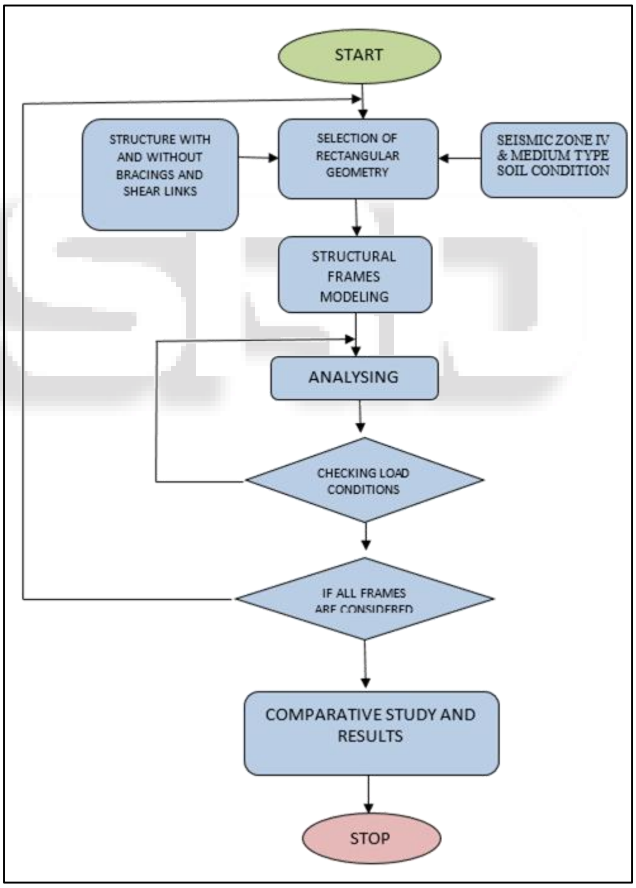

Fig. 3: Flow chart of the study

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 2: Geometrical description

IV. PROBLEM FORMULATION

1) Selected five cases for comparison first one is bare frame,
2) Second is frame with bracing of steel at the corners,
3) Third one is frame with bracings of steel and shear links,
4) Fourth one is bracings of aluminum at the corners,
5) Fifth one is bracings of aluminum and shear links.

A. Case 1: Structure bare Frame:

In this structure without any extra innovative technique is modeled and analysed to compare with other cases to determine the variation in different cases respective to bare frame simple model. Geometry and loading is same for each case to determine the best stable case

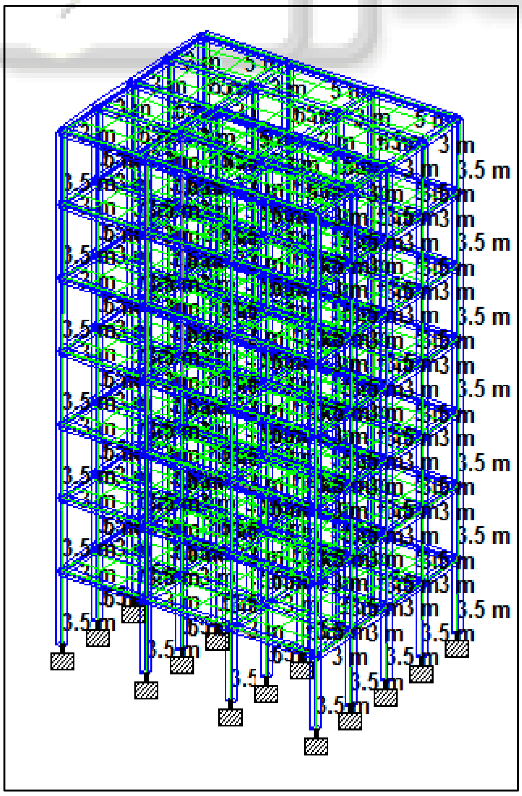

Fig. 4: bare frame

B. Case 2: Structure with steel bracings at corners:

X bracing is introduced at the corners of frame to determine its impact on lateral forces for which in this case they have selected steel as a material of bracing to diagnose its stability for comparative study. Here geometry and loadings are same as of bare frame frame, these steel X bracings are of size 110X 5 mm.

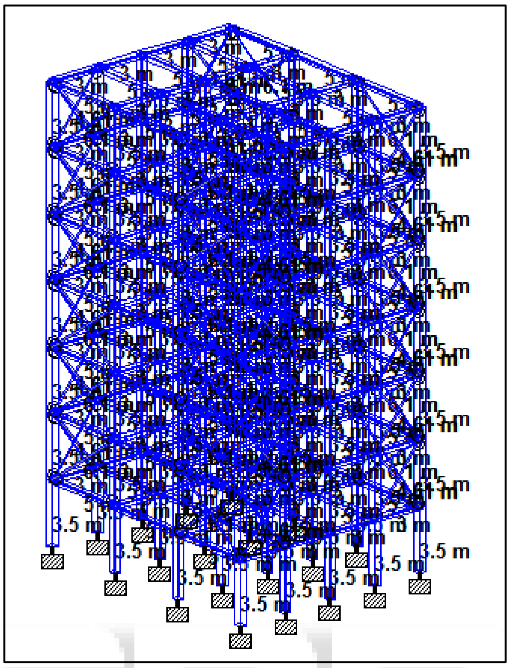

Fig. 5: steel bracings frame

C. Case 3: Structure with steel bracings with shear links:

X bracing with links t the joint is introduced at the corners of frame to determine its impact on lateral forces for which in this case we have selected steel as a material of bracing to diagnose its stability for comparative study and links to resist lateral load more easily with increasing its life span Here geometry and loadings are same as of bare frame frame, these steel X bracings are of size 110X 5 mm wth shear links at the supports of bracings.

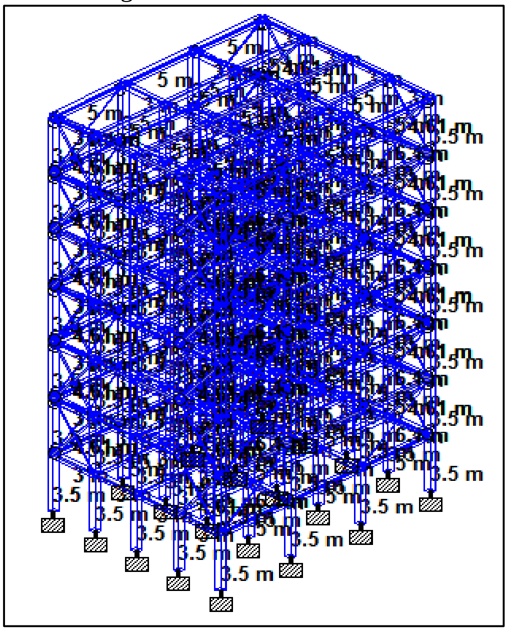

Fig. 6: steel bracings with shear link frame

D. Case 4: Structure with aluminium bracings:

Shows aluminium is taken as a material for bracing to determine its good resistibilty effects comparing to steel bracings In this case X bracing is introduced at the corners of frame to determine its impact on lateral forces Here geometry and loadings are same as of bare frame frame, these aluminium X bracings are of size 110X 5 mm.

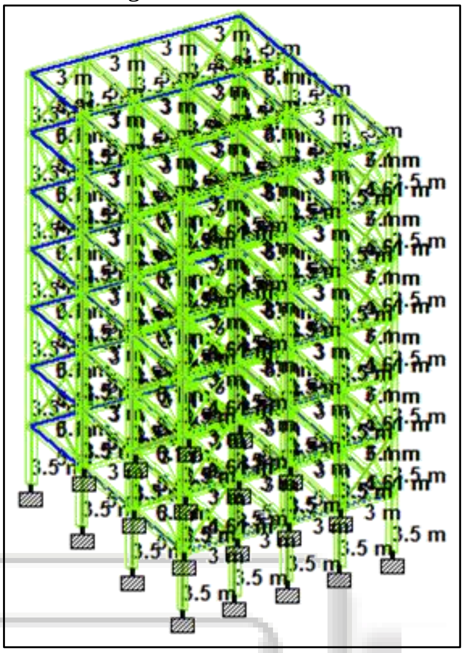

Fig. 7: Aluminium bracings frame

E. Case 5: Structure with aluminium bracings and shear links:

Aluminium is taken as a material for bracing to determine its good resistibilty effects comparing to steel bracings In this case X bracing is introduced at the corners of a frame with shear links to enhance its life and resistivity to determine its impact on lateral forces Here geometry and loadings are same as of bare frame frame, these aluminium X bracings are of size 110X 5 mm with shear links at the supports of bracings.

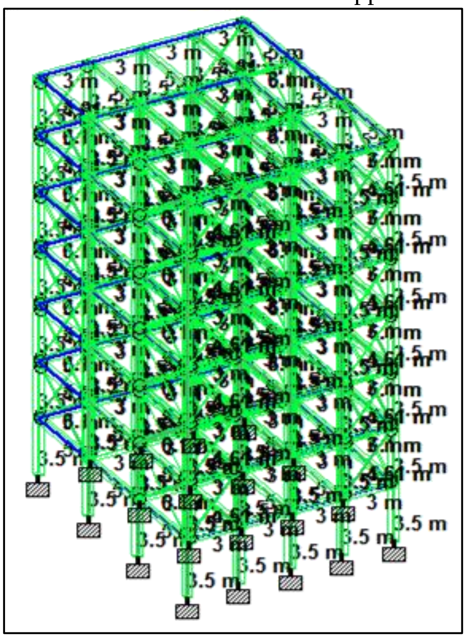

Fig. 8: Aluminum bracings with shear links frame

V. RESULTS & INFERENCES

Structural members					
s.no	B.M (KN m)	Axial force KN	Shear Force KN	qty. concrete in cum	qty. Steel (N)
normal	310. 799	1811. 871	314.66 9	679.98	1797 6
steel bracings	284. 86	3571. 781	288.73	784	1802 3
steel with shear links	210. 862	3032. 354	214.73 2	745	1823 2
aluminium bracings	329. 433	3006. 365	333.30 3	791	1876 4
aluminium with shear links	208. 885	2806. 134	212.75 5	765	1794 2

Table 3: Results analysis

VI. INFERENCES

It is observed from the table above that Maximum Bending moment is minimum in Aluminium with shear link case therefor reinforcement requirement in this case will be minimum.

From the table above it is concluded that Axial force in Y direction is maximum in steel bracings case therefore support reactions will be maximum hence its load transfering value is more comparing to other cases.

From the above table it is clearly observed that unbalace force (shear force) is maximum in aluminium bracing case which will result in increase chances of shear failure.

From the table above it is clearly visible that amount of concrete is minimum in the case of shear link with steel bracing case whereas reinforcement requirement is minimum in aluminium with shear link case.

VII. 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 and also in cost reduction comparing to aluminium links. Here results shows that:

1) Bare frame is showing least quantity of concrete and rebar but it cannot be lateral load resistance in comparison to other cases.
2) Aluminium bracing with links frame system is second economical after bare frame but it will be resistable to lateral load also. It is showing 19.87% less amount of concrete and 24% less amount of rebar than steelbracings system.

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