

# HALF BREED FRAMEWORK FOR MULTISTOREY BUILDINGS

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**Abstract** -This paper includes point by point concentrate on execution of lumber based wood steel crossover multistorey structures. This paper inspects the presentation of wood steel half and half multistorey structures for locales with high seismic risk lists dependent on certain rules like timeframe, base shear and relocation of the framework. Diverse wood-steel half breed models are demonstrated and investigated utilizing limited component based programming SAP2000 to anticipate basic reaction, progressively powerful and financial method of executing shear dividers in the plan. The wood steel half and half structure fuses Cross Laminated Timber (CLT), Oriented Strand Boards and Steel as shear dividers in steel second edges. Static examination and Dynamic investigation are performed on the structure and it is seen that shear dividers essentially lessen the timespan, base shear and dislodging of the steel outline. The focal point of the investigation is on contrasting the key basic exhibitions between various cases including relocation, time period and base shear. The various burdens considered were dead burden, live burden, seismic burdens, and their heap mixes as per IS:1893 (Part-I) 2002.

**Key Words:**Lightweight structure, cross overlaid wood, situated strand loads up, dynamic execution, timespan, base shear, uprooting.

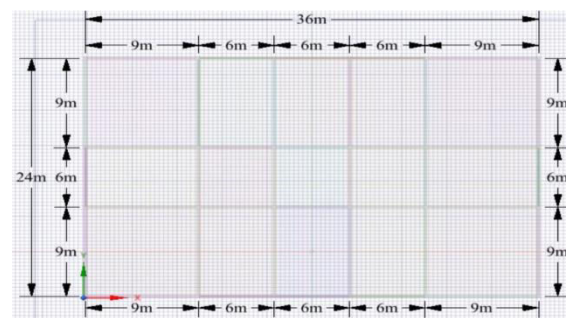
## 1. INTRODUCTION

Wood development is for the most part utilized and most appropriate for multi story structures as it has high solidarity to weight proportion. Wood development is appropriate for earth shake inclined regions as lumber is light in weight. Wood development additionally has a favorable position of decreased burden on establishment when contrasted with conventional fortified cement building. The wood development can be utilized for both private just as business. Appropriately planned lumber structures can have huge number of rooms on each floor additionally it can continue changeless burden in view of changeless divider. Wood development is generally utilized in Europe and Turkey as it has light confining. To increment the sidelong burden

obstruction, increasingly number of dividers is fabricated. In any case, practically speaking lumber multi story structures has an open spaces and not very many dividers. Wood segments and shafts has a confinement that they are obvious from outside. In this paper more spotlight is given on the vitality utilization and a dangerous atmospheric deviation capability of different structure is additionally been advised.

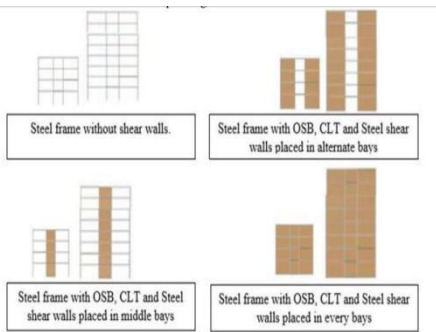
## 2. METHODOLOGY

Fig. 1 shows plan of Half breed framework Wood-Steel building 24m x 36m. Contextual investigations utilizing (G+3) and (G+7) half and half structures will be numerically displayed (Fig.2).



**Fig.1 Plan of half breed wood steel building**

For the development of half and half structure Steel, Cross Laminated Timber and Oriented Strand Board are utilized. First story stature of each building was 4 m and every single other story were 3m tallness. Parts incorporate shafts, segments, chunk furthermore, shear dividers. Bars are the flexural part in the structures. It can move the heaps to sections. The material utilized for the development of pillars is steel which is an I-segment. Shafts are having cross area W310 x 254 x 86 kg/m (Nominal Depth x Width x Weight).



**Fig.2 shows model of (G+3) and (G+7) wood steel hybrid buildings**

Sections are the pressure individuals, which has the ability to move the heaps from pillars. The material utilized for the development of segments is steel which is an I-area. Segments are having cross area W310 x 313 x 179 kg/m (Ostensible Depth x Width x Weight). Chunk is a level bit of wood fills in as a mobile surface. The thickness of the section considered is 150mm. Shear dividers are vertical parts of the even force restricting structure. A shear divider is a divider which is planned to restrict shear, level force which causes most of damage in tremors. The thickness of the shear divider is 100mm. Weights mixes considered including dead weight, live weight and seismic weights. Nuances of the stacks and weight blend are taken by Seems to be: 1893 (Part-I) 2002. (G+3) and (G+7) mutt collecting 3-D constrained part models with SAP2000 were used to predict essential responses under these stacks. Numerical model using floor and divider fragments were shown as four center shell parts. Shaft and Column portions were shown as line segments. Dynamic examination through response extend strategy is used to apply seismic weights on the structure. The repeat and speeding up are taken identifying with seismic zone V.

### 3. MATERIAL PROPERTIES

A half breed framework is a blend of at least two basic materials. Steel and solid hybridization is the most widely recognized kind of crossover framework. Steel structures are normal on the planet on account of its brief term of development and high quality. To improve opposition and to conquer different impediments of individual steel structure it tends to be joined with different materials like half and half frameworks. This task includes definite investigation of half and half wood-steel structures and its application in the development business. Wood and steel compelling hybridization makes a framework wherein just least steel is utilized where high quality and malleability are required. Steel

is a lot more grounded and gives noteworthy post-yield avoidance ability, known as malleability. Steel outlines are incredibly malleable, with enormous disfigurements during seismic occasions. Wood shear dividers are likewise accommodated clasping opposition of the building. Wood shear divider adds to the firmness and quality of the steel outlines accordingly expanding solidness and quality of Cross breed Wood-Steel Structure. Advantages remember increment for pliable limit, seismic execution of the structure, and cost reserve funds.

Half breed frameworks configuration is frequently considered for tasteful reason, supportability, ideal utilization of various material properties. To expound on these kinds of hybridization and their favorable circumstances and challenges, contextual investigations of steel-wood are given. The considered programming bundle is SAP2000.

#### A. Steel (ASTM A36)

Steel is the principle material utilized for the arrangement of the structure. Steel is a material which has great pliability and great quality. Properties of steel alluded from American measures for Material Testing [13].

**TABLE I PROPERTIES OF STEEL (ASTM A36)**

Properties	Steel	Units
Thickness	7850	Kg/m3
Flexible Modulus	200000	Mpa
Yield Strength	250	Mpa
Elasticity	400	Mpa
Poisson's Ratio	0.26	-

#### B. Cross Laminated Timber (CLT)

Cross Laminated Timber is a multi-layer mass wood item produced using sticking layers of strong sawn stumble together. Each layers of sheets are situated opposite to contiguous layers, with the goal that the boards can accomplish better basic inflexibility in both bearings. Properties of Cross Laminated Timber alluded from Canadian Technical Design Guide [14] and ascelibrary.org [15].

**TABLE II PROPERTIES OF CLT**

Properties	CLT	Units
Thickness	485	Kg/m <sup>3</sup>
Versatile Modulus	9500	Mpa
Pressure Quality	20	Mpa
Poisson's Ratio	0.46	-

**C. Arranged Strand Board (OSB)**

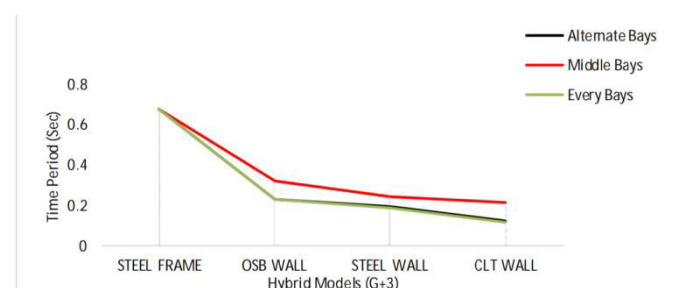
OSB is a tangle framed board item made of strands reinforced with outside sort pitches under warmth and weight. OSB boards comprise of four or five layered mats. Properties of OSB are alluded from the connection [16] and [17].

**TABLE III PROPERTIES OF OSB**

Properties	OSB	Units
Thickness	642	Kg/m <sup>3</sup>
Flexible Modulus (EX)	4160	Mpa
Flexible Modulus (EY)	1650	Mpa
Flexible Modulus (EZ)	400	Mpa
Shear Modulus (GXZ)	85.7	Mpa
Shear Modulus (GYZ)	55.7	Mpa
Shear Modulus (GXY)	1250	Mpa
Poisson's Ratio	0.226	-

**4. RESULT AND DISCUSSIONS**

Assessment of G+3 and G+7 Hybrid wood-steel multistorey structure with various shear divider material in different positions and the results are looked at. The models of the structure is broke down for static assistant appraisal and dynamic assessment. (Fig. 3 and 4) shows the time range for both G+3 and G+7 structures gave OSB, CLT and STEEL shear dividers. It is watched that timespan of steel format without shear dividers is more and with shear dividers is less. It may be seen that for (G+3) half and half structure cases, CLT divider structure has a lot of lower time range close with STEEL divider framework. For G+3 working consequently deltas, time range for STEEL shear dividers is 0.19 seconds and 0.123 seconds (35 % less) for the CLT shear dividers. Also timespan for OSB shear dividers is 0.23 seconds and 0.19 seconds (17 % less) for STEEL shear dividers. Capability between time period estimations of OSB, CLT and STEEL shear dividers introduced in kind straights and every stream is in like way least anyway time length of all the shear divider materials introduced in center cutoff points is more when showed up distinctively corresponding to exchange coves and each inlet. It is seen that for (G+7) structures timespan of steel plot basically decreased in the wake of utilizing shear dividers in all of the three cases. Timeframe of models gave CLT and STEEL shear dividers in Alternate Bays is less when veered from composed strand load up shear dividers. For G+7 working in Alternate Bays, time length for CLT shear dividers is 0.262 seconds and 0.19 seconds (27 % less) for the STEEL shear dividers, while timespan in Every Bays for STEEL shear dividers is 0.188 seconds and 0.186 seconds (1% less) for the wood shear dividers which is a base separation.



**Fig. 3. Timespan of (G+3) Hybrid Buildings**

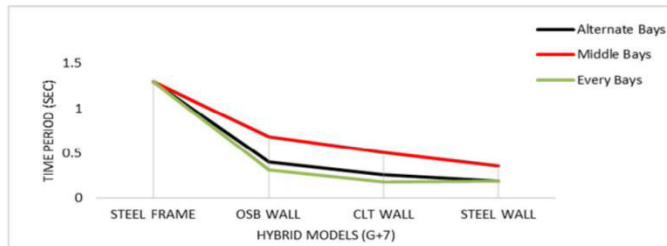


Fig. 4. Timespan of (G+7) Hybrid Buildings

TABLE IV COMPARISON OF BASE SHEAR OF G+3 HYBRID BUILDINGS

	Hybrid Models (G+3)					
	Base Shear-X (kN)			Base Shear-Y (kN)		
	STEEL Wall	CLT Wall	OSB Wall	STEEL Wall	CLT Wall	OSB Wall
Alternate Bays	1023.63	920.53	359.515	909.12	898.43	406.82
Middle Bays	503	262.747	203.331	519	756.67	855.32
Every Bays	1005.99	398.62	279.65	939.88	561.92	369.48

Table. IV shows that base shear in X and Y headings of cross assortment models gave OSB and CLT shear dividers in return straights is less when showed up diversely according to steel shear dividers. For (G+3) crossbreed constructing base shear in X-bearing is about lessened by 65% and in Y direction by 55% when given OSB shear dividers consequently constrains comparable with Steel shear dividers. It is additionally seen that base shear in X-heading of crossbreed models gave OSB and CLT shear dividers in center sounds is less comparative with Steel shear dividers moreover, base shear of models gave steel shear dividers in Y-heading is less separated from OSB and Steel dividers.

Table. V shows that for (G+7) cross breed structure base shear in X-course is about lessened by 23% and in Y-bearing by 6.87% when given OSB shear dividers consequently straights close with Steel shear dividers.

TABLE V COMPARISION OF BASE SHEAR OF G+7 HYBRID BUILDING

	Hybrid Models (G+7)					
	Base Shear-X (kN)			Base Shear-Y (kN)		
	STEEL Wall	CLT Wall	OSB Wall	STEEL Wall	CLT Wall	OSB Wall
Alternate Bays	1888	1640.02	1514.199	1550.8	1488.04	1477.37
Middle Bays	1368.803	1288.03	1135.94	2154.39	1254.52	1187.84
Every Bays	2092.447	1594.7	1570.25	1647.2	1566.85	1534.19

TABLE VI COMPARISION OF DISPLACEMENT OF G+3 HYBRID BUILDING

	Displacement-X (mm)				Displacement-Y (mm)			
	Steel Frame	OSB Wall	CLT Wall	Steel Wall	Steel Frame	OSB Wall	CLT Wall	Steel Wall
Alternate Bays	11.51	7.51	3.04	0.5	16.68	10.38	3.12	1.09
Middle Bays	11.51	3.32	1.21	0.57	16.68	6.39	3.14	1.31
Every Bays	11.51	7.54	3.08	0.39	16.68	10.4	3.1	0.82

TABLE VII COMPARISION OF DISPLACEMENT OF G+7 HYBRID BUILDING

	Displacement-X (mm)				Displacement-Y (mm)			
	Steel Frame	OSB Wall	CLT Wall	Steel Wall	Steel Frame	OSB Wall	CLT Wall	Steel Wall
Alternate Bays	24.23	13.38	4.42	0.51	31.16	13.87	5.02	1.1
Middle Bays	24.23	7.225	2.982	0.58	31.16	18.77	12.62	6.66
Every Bays	24.23	13.1	3.175	0.392	31.16	11.59	3.73	0.804

Table VI and VII shows that movement of the steel design from a general perspective diminished resulting to utilizing shear dividers. For (G+3) Hybrid Structures evacuating is decreased by 73.58% in X-bearing and 81.3 % in Y-course of steel chart when cross overlaid lurch shear dividers introduced in kind bayous. While Displacement is diminished by 73.24% in X-course and 81.41 % in Y-heading of steel plot when cross made sure about wood shear dividers introduced in every waterway. For (G+7) Hybrid Buildings dislodging is lessened by 81.75 % in X-heading and 83.88 % in Y-course of steel plot when cross made sure about bumble shear dividers introduced in exchange straights. While Displacement is reduced by 86.9% in X-heading and 88 % in Y-direction of steel format when cross overlaid wander shear dividers introduced in each stable. The rate capability between evacuating respects in substitute channels and in each Cross assortment Models (G+7)



## 5. CONCLUSIONS

In this paper various types of timber construction are briefed. The comparison between timber, concrete, steel and timber plus material for construction for energy consumption and GWP is made. Life cycle of the buildings, new GWP emissions for the timber made construction houses are more only by 10% as compared to concrete and steel building. The very reason behind this is heavy amount of carbon is stored in wood based building and it does balance GWP. The hybrid beams, their advantages and applications in multistory buildings are very crucial. The buildings are made attractive, efficient, and low cost with same capacity of handling the load with the help of hybrid concept presented in this paper. In this paper different sorts of wood development are advised. The correlation between wood, solid, steel what's more, wood in addition to material for development for vitality utilization and GWP is made. Life pattern of the structures, new GWP discharges for the wood made development houses are all the more just by 10% when contrasted with concrete furthermore, steel building. The very explanation for this is overwhelming measure of carbon is put away in wood based structure and it does balance GWP. The half and half pillars, their points of interest and applications in multistory structures are very essential. The structures are made appealing, effective, and ease with same limit of taking care of the heap with the assistance of half and half idea introduced in this paper.

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