

# Analysis of A High Rise Building Frame Considering Hybrid Shear Wall Under Lateral Load Using ETABS

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Article Info	ABSTRACT
March-April-2022	Shear dividers are primary components that safeguard structures from parallel
March April 2022	loads like breeze and quakes. Whenever the outside dividers of a structure are
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	inadequately solid and firm, shear dividers are added to the inside to give more
Volume 6, Issue 2	noteworthy strength and solidness. At the point when the allowable range
	width proportion for the floor or rooftop stomach is surpassed, these shear
<b>Page Number :</b> 176-189	dividers are required. Shear dividers are flexural individuals that are usually
	utilized in high-and low-ascent structures to forestall all out breakdown because
Article History	of seismic burdens.
Accepted : 01 April 2022	Here half breed shear divider implies a blend of shear divider and X supporting
Published : 09 April 2022	This examination is engaged towards introducing the way of behaving of
-	construction considering three unique cases to be specific, structure with X
	propping at corner, structure with shear divider at corner and design with
	crossover shear divider at corner. The construction was demonstrated and
	examined utilizing logical application ETABS v 2016. The boundaries of
	examination were Story relocation, story shear. Story float, story firmness and
	base shear.
	Keywords: Hybrid Shear Wall, Response Spectrum Analysis, ShearWall, Seismic
	Forces.
	regular burdens brought about by gravity. Structures

## I. INTRODUCTION

To safely convey gravity and parallel burdens, tall structure configuration involves a reasonable plan, guess investigation, starter plan, and improvement. The essential objective of all underlying frameworks utilized in the development of constructions is to move gravitational loads really. Dead burden, dynamic burden, and snow load are the three most regular burdens brought about by gravity. Structures are additionally powerless against sidelong loads prompted by wind and seismic powers, notwithstanding these upward loads. High burdens, influence development, and vibration can be generally brought about by horizontal burdens. Accordingly, it's important that the construction be sufficiently able to endure vertical burdens while as yet being adequately solid to endure horizontal anxieties. Tall structures can be seen as everywhere.



The foundational layout of elevated structures joins wind and tremor dynamic estimations. PC execution has worked on emphatically as of late, and basically all underlying creators currently use PC programming for elevated structure foundational layout. In elevated structures helpless to sidelong wind and seismic anxieties, shear dividers are incredibly basic. Wind, seismic tremor, and lopsided settlement loads, alongside the heaviness of the construction and its occupants, produce extreme bending (twist) powers. These powers can in a real sense tear (shear) a design separated. The state of an edge is kept up with and revolution at the joints is forestalled by associating or introducing a firm divider inside it. It is given, when the focal point of gravity of building region and burdens followed up on it contrasts by over 30%. To bring the C.G. in scope of 30% substantial divider is given sidelong powers may not build much.Shear divider gives better reaction on the off chance that it is given at ideal area. The shear's divider will likely glance at the different ways that tall designs can be balanced out against the effects of weighty level breeze and seismic burdens.

The static and dynamic underlying reactions of elevated structures are affected by the disseminations of cross over shear firmness and bowing solidness per story. "Sooner or later after the structure's underlying development and occupation, making changes to the structure's frameworks, or perhaps the actual construction.

### Hybrid shearwall

Half breed frameworks are broadly used all over the planet and can be found in an assortment of developments made of an assortment of materials. Any framework that incorporates at least two primary materials is alluded to as a cross breed framework. Steel and substantial hybridization is the most famous among crossover frameworks; models remember a substantial for metal deck upheld by steel radiates as a story framework. For a long time, fiber built up polymers (FRP) materials have been used in primary designing to fortify supported or squeezed substantial constructions, and to build the limit of extensions, dams, and cylinders. GFRP and CFRP are the most generally involved filaments for reinforcing in light of the fact that they enjoy different benefits like high strength properties, max malleable proportion, simplicity of utilization, and protection from erosion. The half breed coupled shear divider framework (HCW) is one of the most inventive and savvy primary frameworks that has been tried. It is made involved a RC shear divider that is joined to two side steel sections by replaceable steel coupling joins. The principal plan objective of this framework is to bear parallel burdens with insignificant or no harm to non-replaceable parts, (for example, the RC divider and steel segments), while the replaceable coupling steel connections might be seriously harmed. This technique actually has a ton of openings in it, like examinations and thorough assessments, and it's wasteful in low-ascent structures.

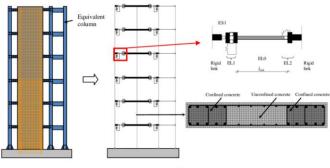


Fig 1 Hybrid Shear Wall

### **II. LITERATURE REVIEW**

Saleem Malik Yarnal et al (2015) As mode form, basic frequency base shear, drift, shear force, and stiffness were investigated in the seismic analysis of shear wall buildings in zone III with 10%, 20%, 30%, and 40% openings and without openings. The performance of the shear wall was evaluated with different



percentages of shear wall apertures. ETABS, an analytical application, was used to model the data. Uniformly distributed lateral loading, triangularly distributed lateral loading, and a maximum value at the top comprise the structure's analysis.

According to the observations, the base shear for ten percent, twenty percent, thirty percent, and forty percent was smaller than the base shear for a shear wall without opening. The frequency of ten percent, twenty percent, thirty percent, and forty percent was lower than the shear wall without opening. With the increase in openness, the frequency drops. The time duration for 10%, 20%, 30%, and 40% apertures was longer than the time period for a shear wall with no opening. With an increase in openness, the time period lengthens. When the storey drift of a building with a 10%, 20%, 30%, or 40% opening in the shear wall was compared to the storey drift of a building without an opening in the shear wall, the storey drift of a building with a 10%, 20%, 30%, or 40% opening was greater than the storey drift of a building without an opening.

Thavera Wihardja and Iswandi Imran (2017) research paper described a study on the use of the Hybrid Coupled Wall System (HCWS) in seismic-resistant high-rise RC buildings. The project consisted of a 25story office building with three types of connection beams and three types of walls distributed across the tower's height and was constructed in a seismically active area. Using a performance-based design method, the study established an efficient design for RC structures with Coupling Ratio (CR) values of 64.55 percent and influenced the behaviour of the wall pier in the upper section of the structure where severe plastification and earlier crushing failure occur. Results stated that the structure has high CR values, CR>60%, has more widespread cracking in the upper portions of the wall piers and suffered earlier crushing failure of the wall. Hence, results concluded that steel coupling beams can be used as an alternative with satisfying all performance criteria and perform at Life Safety(LS).

## **Objectives:**

In this study R.C.C. building is demonstrated, dissected and planned. Plan of shear divider without help from anyone else is an investigation of interest Vs limit proportion stuck to the properties of shear divider segments. This can be produced by the numerical model made in Etabs by considering the tremor and wind powers.

 Behavior investigation of 10 story skyscraper RCC structure with X propping, shear dividers and mixture shear divider is for seismic and wind loads.
 The variety of story floats of the models to be researched.

3) The variety of removal must be examined.

4) It is important to perform both comparative static examination and reaction range investigation.5) Identify the reaction of three primary framework for balanced structure.

### III. Methodology

Step 1 Reviewing research papers published by different authors in order to identify the scope of the research.

Step 2 Defining grid system data for x and y coordinates. In ETABS, X coordinates are defined on grid ID as A, B, C etc and Y coordinates as 1, 2, 3 etc. The Z direction defined the storey height.



Grid Syster	n Name			Range Option			Click to Modif					
G1				) Default				Reference Points		Ø	• • •	) () (E) (F)
System Ori	gin			User Specified				Reference Planes		6		
Global	x	0	m	Top Story			Options			(4)		
Global	Y	0	m	Bottom Story			Bubble Siz	e 1000	mm	3-		
Rotatior	1	0	deg				Grid Color					
X Grid [		Data as Ordinates X Ordinate (m)	Visible	) Display Grid Data Bubble Loc	a as Spacir	ng	Y Grid Data	Y Ordinate (m)	Quick Visible	Start New Rectan Bubble Loc	gular G	nds
X Grid [	Data rid ID	X Ordinate (m)	Visible	Bubble Loc		_	Grid ID		Visible	Bubble Loc		
X Grid [	Data rid ID B	X Ordinate (m) 5	Visible Yes	Bubble Loc End		Add	Grid ID 2	5	Visible Yes	Bubble Loc Start		Add
X Grid [	Data rid ID B C	X Ordinate (m) 5 10	Visible Yes Yes	Bubble Loc End End		_	Grid ID 2 3	5	Visible Yes Yes	Bubble Loc Start Start		
X Grid [	Data rid ID B C D	X Ordinate (m) 5 10 15	Visible Yes Yes Yes	Bubble Loc End End End		Add	Grid ID 2 3 4	5 10 15	Visible Yes Yes Yes	Bubble Loc Start Start Start		Add
X Grid [	Data rid ID B C	X Ordinate (m) 5 10	Visible Yes Yes	Bubble Loc End End		Add	Grid ID 2 3	5	Visible Yes Yes	Bubble Loc Start Start		Add
X Grid [	Data rid ID B C D E	X Ordinate (m) 5 10 15 20	Visible Yes Yes Yes Yes	Bubble Loc End End End End End		Add Delete	Grid ID 2 3 4 5	5 10 15 20	Visible Yes Yes Yes Yes	Bubble Loc Start Start Start Start Start		Add Delete

## Fig 2 Grid System Data

Step 3 Defining structure object and applying simple storey data, here number of storey is G+10 with typical storey and bottom height is 3.2 m.

ew Model Quick Templates			
Grid Dimensions (Plan)		Story Dimensions	
O Uniform Grid Spacing		Simple Story Data	
Number of Grid Lines in X Direction		Number of Stories	10
Number of Grid Lines in Y Direction		Typical Story Height	3.2 m
Spacing of Grids in X Direction		Bottom Story Height	3.2 m
Spacing of Grids in Y Direction			
Specify Grid Labeling Options	Grid Labels		
Custom Grid Spacing		O Custom Story Data	
Specify Data for Grid Lines	Edit Grid Data	Specify Custom Story Data	Edit Story Data
Add Structural Objects	Deck Staggered Truss	Flat Slab With Perimeter Beams	Waffle Slab Two Way or Ribbed Slab
	ОК	Cancel	

## Fig 3 Model Template

Step 3 This step defines the properties of material as here RCC structure is considered with X bracing, shear wall and hybrid shear wall.



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General Data				
Material Name	M30	<u>M30</u>		
Material Type	Concrete ~		$\sim$	
Directional Symmetry Type	Isotropic	Isotropic ~		
Material Display Color		Change		
Material Notes	Modify	y/Show Notes		
Material Weight and Mass				
Specify Weight Density	Specific	cify Mass Density		
Weight per Unit Volume		24.9926	kN/m³	
Mass per Unit Volume		2548.538	kg/m³	
Mechanical Property Data				
Modulus of Elasticity, E		27386.13	MPa	
Poisson's Ratio, U		0.2		
Coefficient of Thermal Expansion, A		0.000055	1/C	
Shear Modulus, G		11410.89	MPa	
Design Property Data				
Modify/Show M	Naterial Property	Design Data	]	
Advanced Material Property Data				
Nonlinear Material Data		Material Damping Pr	roperties	
Time D	ependent Prope	erties		

Fig 4 Defining property of concrete (M30)

General Data			
Material Name	Fe345		
Material Type	Steel		$\sim$
Directional Symmetry Type	Isotropic		$\sim$
Material Display Color		Change	
Material Notes	Modify/	Show Notes	
Material Weight and Mass			
Specify Weight Density	Specif	fy Mass Density	
Weight per Unit Volume		76.9729	kN/m³
Mass per Unit Volume		7849.047	kg/m³
Mechanical Property Data			
Modulus of Elasticity, E		210000	MPa
Poisson's Ratio,U		0.3	
Coefficient of Thermal Expansion, A		0.0000117	1/C
Shear Modulus, G		80769.23	MPa
Design Property Data			
Modify/Show Mat	erial Property D	esign Data	
Advanced Material Property Data			
Nonlinear Material Data	N	Naterial Damping Pro	operties
Time Dep	endent Propert	ties	
OK	Ca	ncel	

Fig 5 Defining properties of steel



Step 4 Defining section data for beam, column, slab, X bracing system and shear wall

Frame Section Property Data		×
General Data		
Property Name	beam	
Material	M30 ~	2
Notional Size Data	Modify/Show Notional Size	3
Display Color	Change	↓ ↓ ↓
Notes	Modify/Show Notes	• •
Shape		• • •
Section Shape	Concrete Rectangular $\sim$	
Section Property Source Source: User Defined		Property Modifiers
Section Dimensions		Modify/Show Modifiers
Depth	450 mm	Currently Default
Width	250 mm	Reinforcement
		Modify/Show Rebar
S	how Section Properties	OK Cancel

Fig 6 Defining section properties for beam

eneral Data Property Name Material Notional Size Data Display Color Notes	Column M30 Modify/Show Notional Size Change	···· 2 • • • • • • • • • • • • • • • • •
Material Notional Size Data Display Color	M30 ~ Modify/Show Notional Size	2
Notional Size Data Display Color	Modify/Show Notional Size	• •
Display Color		
	Change	
Notes		• <del>&lt; +</del> •
	Modify/Show Notes	• •
nape		• • •
Section Shape	Concrete Rectangular 🗸 🗸	
ection Property Source		
Source: User Defined		Property Modifiers
		Modify/Show Modifiers
ection Dimensions		Currently Default
Depth		mm Reinforcement
Width	450	mm Modify/Show Rebar
		Modily/ Show Hobdi
		ОК
Shov	v Section Properties	Cancel

Fig 7 Defining properties of column

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Ge						
	Property Name		Slab1			
	Slab Material		M30		~	
	Notional Size Data		Modify/Sho	ow Notional	Size	
	Modeling Type		Shell-Thin		~	
	Modifiers (Currently De	efault)	Modify/Show			
	Display Color		Change			
	Property Notes		Modify/Show			
Pro	operty Data					
	Туре		Slab		~	
	Thickness			200		mm
		ок Fig 8 Defini	Cance			
e Section F	Property Reinforcemen	Fig 8 Defini	Cance			
ign Type	Property Reinforcemen	Fig 8 Defini nt Data Rebar Mat	ing properties c			
ign Type		Fig 8 Defini nt Data Rebar Mat	ing properties o			~
gn Type ) P-M2-M3	Property Reinforcemen	Fig 8 Defini at Data Rebar Mat Longitu	ing properties c	of slab		· · · · · · · · · · · · · · · · · · ·
ign Type ) P-M2-M3 ) M3 Desiç	Property Reinforcemen 3 Design (Column)	Fig 8 Defini nt Data Rebar Mat Longitu Confine	ing properties o terial udinal Bars	hysD415 HysD415	for Ductile	~
ign Type ) P-M2-M3 ) M3 Desig erto Longit	Property Reinforcemen 3 Design (Column) gn Only (Beam)	Fig 8 Defini nt Data Rebar Mat Longitu Confine	ing properties o terial udinal Bars ement Bars (Ties)	of slab HYSD415 HYSD415 rea Overwrites	for Ductile	~
gn Type ) P-M2-M3 ) M3 Desig erto Longiti op Bars	Property Reinforcemen B Design (Column) gn Only (Beam) udinal Rebar Group Cent	Fig 8 Defini nt Data Rebar Mat Longitu Confine	ing properties of terial udinal Bars ement Bars (Ties) Reinforcement Ar	of slab HYSD415 HYSD415 ea Overwrites End		V
ign Type ) P-M2-M3 ) M3 Desig	Property Reinforcemen B Design (Column) gn Only (Beam) udinal Rebar Group Cent	Fig 8 Defini nt Data Rebar Mat Longitu Confine	terial udinal Bars ement Bars (Ties) Reinforcement Ar Top Bars at I-	of slab HYSD415 HYSD415 rea Overwrites End End	0	Beams mm <sup>2</sup>
gn Type ) P-M2-M3 ) M3 Desig erto Longiti op Bars	Property Reinforcemen B Design (Column) gn Only (Beam) udinal Rebar Group Cent	Fig 8 Defini nt Data Rebar Mat Longitu Confine	terial udinal Bars ement Bars (Ties) Reinforcement Ar Top Bars at I- Top Bars at J-	of slab HYSD415 HYSD415 rea Overwrites End End t I-End	0	Beams     mm <sup>2</sup> mm <sup>2</sup>

Fig 9 Defining section properties of reinforcement data



General Data			
Property Name	bracing X type		
Material	Fe345	~	2
Display Color	Chang	e	3
Notes	Modify/Show Notes	s	ě –
Shape			
Section Shape	Steel I/Wide Flange	$\sim$	
Section Property Source			
Source: User Defined			
Section Dimensions			Property Modifiers
Total Depth	450	mm	Modify/Show Modifiers
Top Flange Width	250	mm	Currently Default
Top Flange Thickness	25	mm	
Web Thickness	13	mm	
Bottom Flange Width	250	mm	
Bottom Flange Thickness	25	mm	
			OK



Design Type	Rebar Material				
P-M2-M3 Design (Column)	Longitudina	l Bars	HYSD415		~
O M3 Design Only (Beam)	Confinement Bars (Ties)		HYSD415 ~		
leinforcement Configuration	Confinement B	ars	Check/Des	ign	
<ul> <li>Rectangular</li> </ul>	Ties		O Rein	forcement to be C	hecked
O Circular	<ul> <li>Spirals</li> </ul>		Rein	forcement to be [	)esigned
ongitudinal Bars					
Clear Cover for Confinement Bars				40	mm
Number of Longitudinal Bars Along 3	-dir Face			3	
Number of Longitudinal Bars Along 2	-dir Face			5	
Longitudinal Bar Size and Area		20	~	. 314	mm²
Comer Bar Size and Area		20	~	. 314	mm²
onfinement Bars					
Confinement Bar Size and Area		10	~	. 79	mm²
Longitudinal Spacing of Confinement	Bars (Along 1-Axis)			150	mm
Number of Confinement Bars in 3-dir				3	
Number of Confinement Bars in 2-dir				3	
	ОК	Cance			

Fig 11 Frame section property reinforcement data fro design type and rebar material



General Data	
Property Name	shear wall
Property Type	Specified $\checkmark$
Wall Material	мзо ~
Notional Size Data	Modify/Show Notional Size
Modeling Type	Shell-Thin $\checkmark$
Modifiers (Currently Default)	Modify/Show
Display Color	Change
Property Notes	Modify/Show
Property Data	
Thickness	200 mm

## Fig 12 Defining properties of shear wall

Step 5 Defining load pattern for dead, live and seismic

Model Explorer	Q.Q.Q.() // 3-d m; #; 5) 6d 含 \$ 50 0 0 • 0 • □ ∀ μμ [1] 4; [1] 4; [1] • 1 • 1 • 1 • 1 • 1 • 2 • 7 • 1 • 200 • C • ∠ • [0 • • • • • • • • • • • • • • • • •	
Model Dirgisy Tables Reports Detailing ■ Model ● Ground Head Sectors Detailing ● Ground Head Head Head Head Head Head Head Hea		
	Loads         Type         Self Weight Multiple         Auto Lateral Load         Clok To:           EQ         Seemo         0         ISI333 2002         Add New Load           Dead         0         ISI333 2002         Modify Load           Leve         0         Isi333 2002         Modify Load	
	Exp     Control     Issues     Model       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002       Image: Selemic Load Pattern - Indian IS1999.2002     Image: Selemic Load Pattern - Indian IS1999.2002     Imag	
	Ecc. Ratio (4) Daph.)     0.05       Overwrite Eccentricities     Overwrite	
	Story Range Time Period Top Story Story O V Bottom Story Base V Program Calculated	
	Factors         O Leer Defined         T =         000           Response Reduction, R         5         OK         Cancel	

Fig 13 Defining seismic load pattern as per IS 1893 part I 2016



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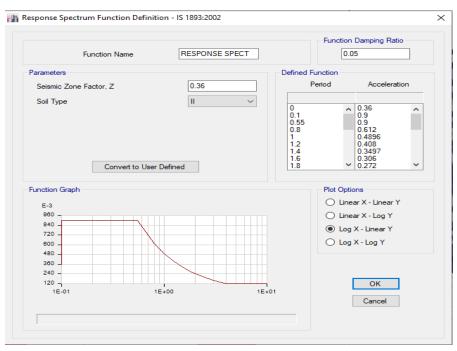


Fig 14 Defining response spectrum function

Load Case Name Load Case Type Exclude Objects in this Group Mass Source		EQ Response Spectrum ~ Not Applicable Previous (MsSrc1)		Design
				∨ Notes
				ads Applied
Load Type	Load Name	Function	Scale Factor	0
Acceleration	U1	Default Uniform	9806.65	Add
Acceleration	U2	Default Uniform	9806.65	Delete
Acceleration	U3	✓ Default Uniform	9806.65	
Modal Load Case		Modal	~	•
Modal Combination Me		CQC	~	•
		CQC Rigid Frequency, f1	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	•] •] •-
Modal Combination Me		CQC	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	-
Modal Combination Me	Response	CQC Rigid Frequency, f1 Rigid Frequency, f2		-
Modal Combination Me	<b>I Response</b>	CQC Rigid Frequency, f1 Rigid Frequency, f2		
Modal Combination Me	<b>I Response</b>	CQC Rigid Frequency, f1 Rigid Frequency, f2 Periodic + Rigid Type CQC3		
Modal Combination Me	ation, td • Type	CQC Rigid Frequency, f1 Rigid Frequency, f2 Periodic + Rigid Type CQC3		

Fig 15 Defining Load case data for Response Spectrum

Step 6 Analyzing the structure for displacement, drift and shear force



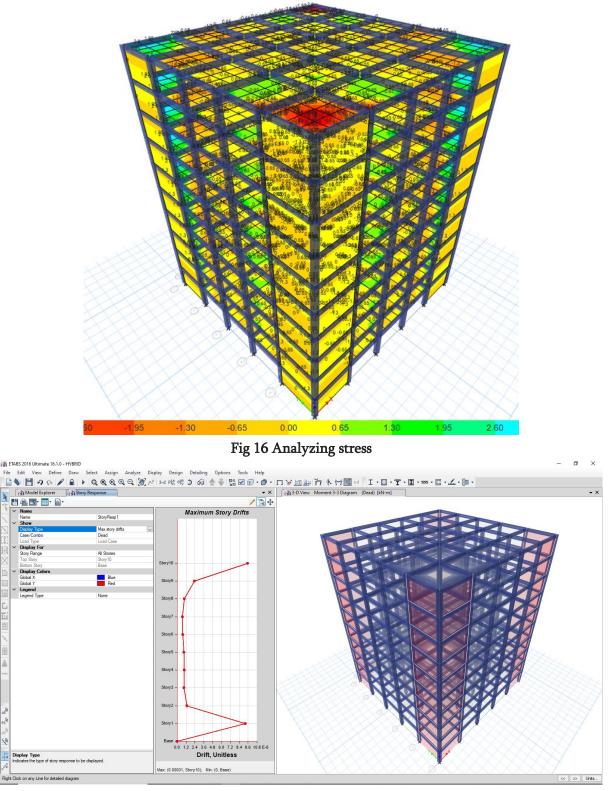


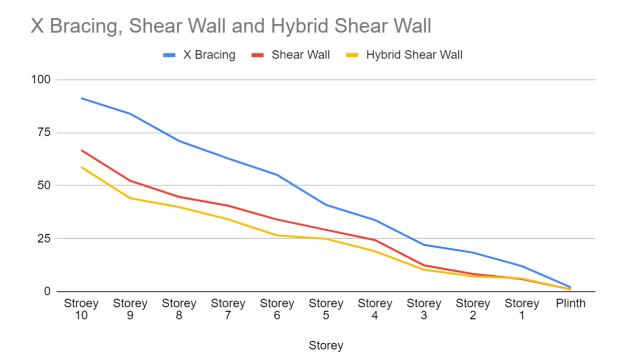
Fig 17 Storey Drift



### Table 1: Geometrical data

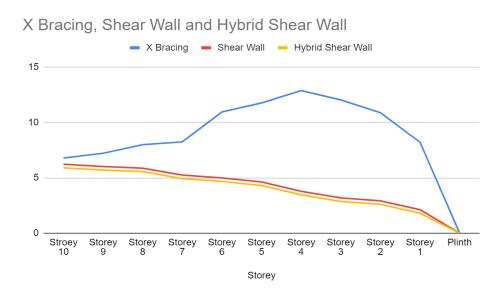
Geometrical Description of Symmetrical Building					
Length in X-direction	25m				
Length in Y-direction	25m				
Floor to Floor Height	3m				
Total Height of Building	30m				
Slab Thickness	200mm				
Wall Thickness	230mm				
Shear wall Thickness	200mm				
Column Size	450X450mm				
Beam Size	450X250mm				

## Analysis result: Displacement;

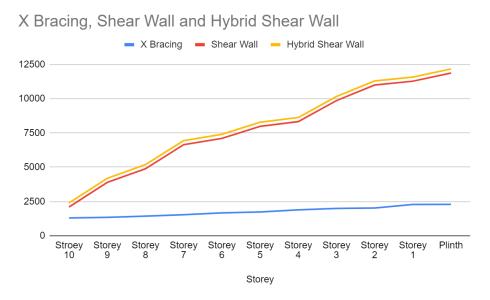




### Storey drift"



### Storey Shear:



### IV. Conclusion

- Story dislodging is the parallel removal of the story comparative with the base. It is the all out dislodging of the story as for the ground. Contrasted with X propping and shear divider, the half breed shear divider structure has lower removal values.
- Story Drift is characterized as the proportion of uprooting of two back to back floor to stature of that floor. Contrasted with X supporting and shear structure, the cross breed Shear divider

structure have lower Drift proportions. Story float of building is inside the cutoff as proviso no 7.11.1 of IS-1893 (Part-1):2016.

- Story shear factor is the proportion of the story shear force when story breakdown happens to the story shear force when absolute breakdown happens. Here the story shear was least with structure with X supporting in contrast with other two cases.
- Story firmness is assessed as the parallel power creating unit translational sidelong deformity in that story, with the lower part of the story



limited from moving horizontally, i.e., just translational movement of the lower part of the story is controlled while it is allowed to pivot. Most extreme story firmness was investigated in structure with shear divider when contrasted with structure with x propping and structure with half breed shear divider.

Base shear is a gauge of the greatest expected parallel power on the foundation of the design because of seismic action. It is determined utilizing the seismic zone, soil material, and construction regulation horizontal power conditions. Here the base shear was observed greatest in structure with mixture shear divider at corner in contrast with structure with shear divider and construction with x supporting.

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