

Seismic analysis of Shopping Complex with Shear walls and Bracings using ETABS

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ABSTRACT: Buildings constitute a part of the definition of civilizations, a way of life advanced by the people. A shopping mall is a modern, chiefly North American, term for a form of shopping precinct or shopping centre, in which one or more buildings form a complex of shops representing merchandises with interconnecting walkways that enable customers to walk from unit to unit. Shear wall is a basic important structural component. These walls can be utilized for giving more strength & safety to the structure, when the structures are subjected to external loads, such as earthquake loads, wind loads etc. 4 storey building is considered for the investigation of structure. These buildings are assumed to be situated in zone II. These are analyzed by changing the positions of shear walls symmetrically by considering different shape and locations of the shear walls in buildings. In present study, the seismic performance of steel structure rehabilitated using concentric and eccentric bracing is investigated. The braces are provided for peripheral columns. A G+3 building is analysed for seismic zone II as per IS 1893:2002 using E-tabs 2015 version software.

KEYWORDS: Shear wall, Bracings, Equivalent static method, Etabs, Shopping complex.

I. INTRODUCTION

We need shopping malls because it is so much easier having a whole pile of shops in one place. We use these shops often and not having to travel far is good. It is also great as we use some these shops very often and relies other products we need from other stores. A shopping mall is a modern, chiefly North American, term for a form of shopping precinct or shopping centre, in which one or more buildings form a complex of shops representing merchandises with interconnecting walkways that enable customers to walk from unit to unit.

SHEAR WALL

Shear walls are utilized to withstand the bending moments of a building, because of lateral loads. They act as vertical cantilevers to give the essential stiffness in a building. Shear deformation are of course present but are negligible compared to bending wall rather than a shear wall. They are usually given between columns, in stairs, lift walls, etc., in the structures under seismic forces.

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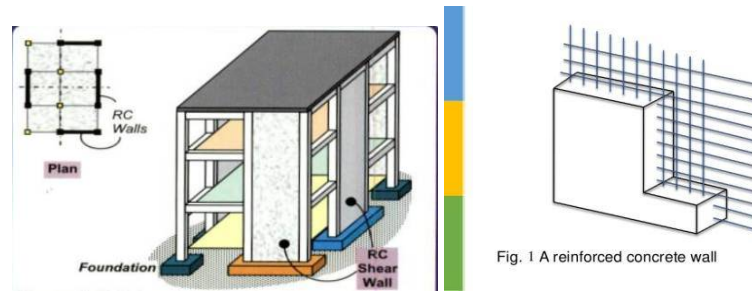


Fig. 1 A reinforced concrete wall

Figure 1: Shear Wall (14)

BRACING SYSTEM

These days High Rise Steel edge building is well setting up in metro urban areas. For development of elevated structure supporting are built for solidness and parallel burden resistance reason. The improvement of this method made the development of the high rise conceivable. Bracings are solid in pressure. Supporting with their encompassing casings must be considered for expansion in parallel burden opposing limit of structure. At the point when bracings are set in steel outline it carries on as corner to corner pressure transmits pressure power to another joint. Varieties in the segment solidness can impact the method of displacement and sidelong firmness of the bracing.

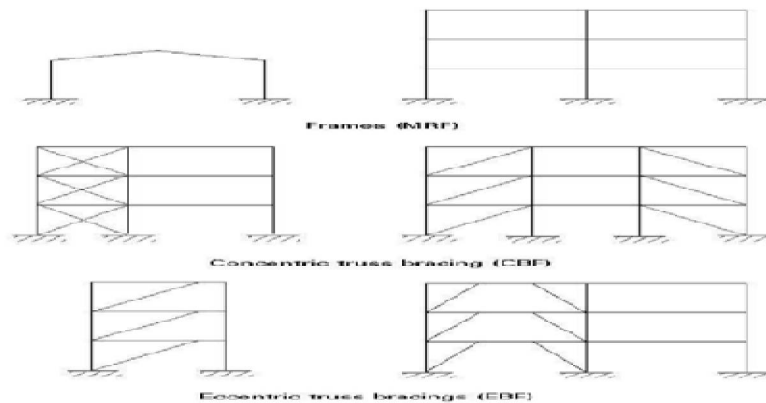


Figure 2: Types of Bracings (4)

LOAD CONSIDERED

Part – 1: Dead loads.

Part – 2: Imposed (Live) loads.

IS 1893: 2002 – criteria for earthquake resistant design of structure (fourth revision).

II. METHODOLOGY

EQUIVALENT STATIC METHOD

This approach defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum. It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when the ground moves. The response is read from a design response spectrum, given the natural frequency of the building (either

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calculated or defined by the building code). The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting

PLAN DETAILS

BUILDING PARAMETERS

Length along x- direction	= 49.7m	Shear wall thickness	= 150 mm
Length along y-direction	= 59.7 m	Support condition	= Fixed.
No of storey	= 4	Each storey height	= 3.0 m
Main beam	= (250×450) mm	Main column	= (450×450) mm
Slab thickness	= 150 mm.	Wall thickness	= 230 mm

MATERIALS PROPERTIES

1. STEEL

Modulus of elasticity	E = 200Gpa	Poisson's ratio	$\mu = 0.17$
Steel density	= 77kN/m ³ (7850kg/m ³)	Ultimate yield strength of steel	F _y = 250Mpa
Yield strength of steel	F _y = 415Mpa		

2. CONCRETE

Density of concrete	= 25 kN/m ³		
Characteristic strength of concrete	= 25 Mpa		
Loads assigned			
Dead Load	= 2 kN/m ²	Live Load	= 4.5 kN/m ²

III. PLANNING & MODELS

The following figures 3(a) and 3(b) represents the AUTOCAD Plan and Beam-Column Layout of the proposed plan of the shopping complex.

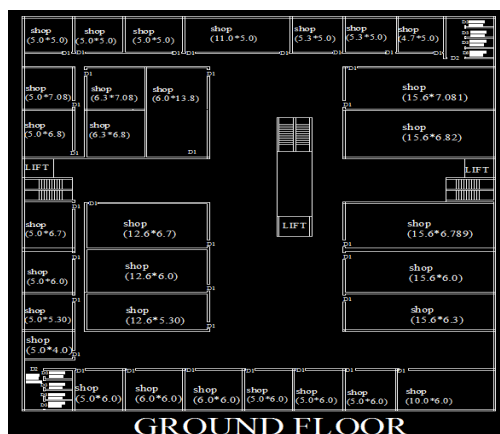


Figure 3(a)

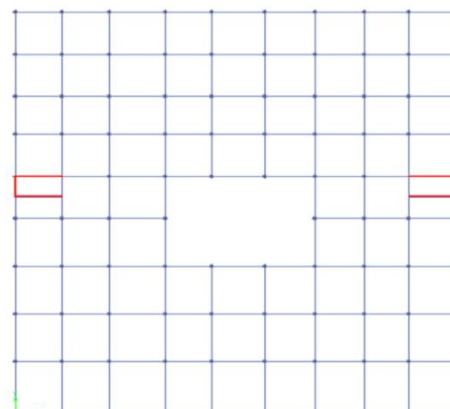


Figure 3(b)

The following figures shows the 3D modelling of the different types of shear wall provided at different locations along with bare frame. Figures 3(c) Bare Frame, 3(d) Shear Wall at Mid Frame, 3(e) Shear Wall at Corners, 3(f) Shear Wall at Mid Frame

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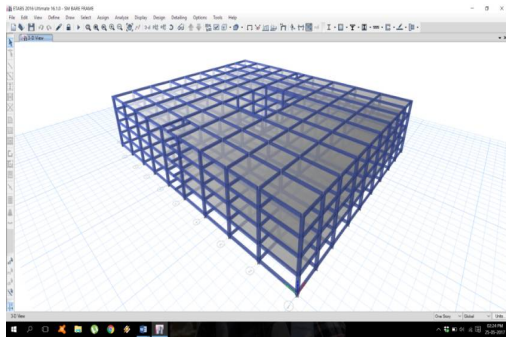


Figure 3(c)

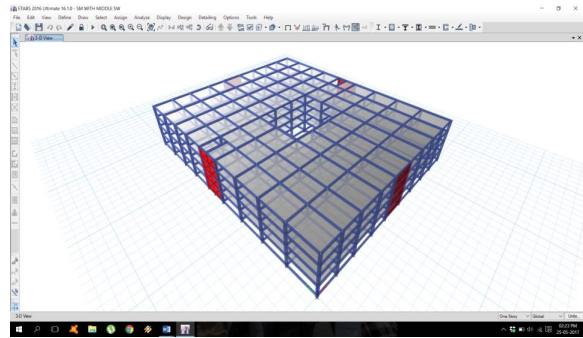


Figure 3(d)

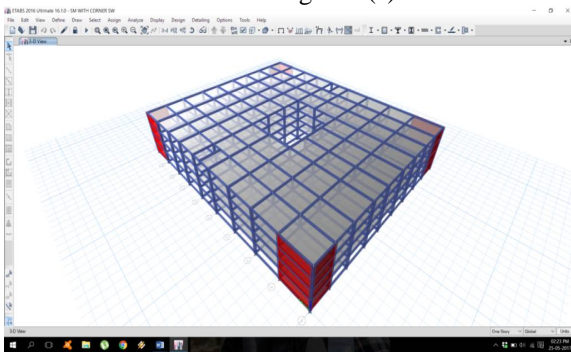


Figure 3(e)

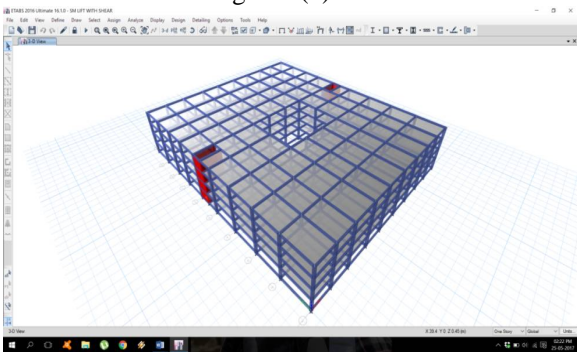


Figure 3(f)

The following figures shows the 3D modelling of the different types of bracings provided at the periphery of the model. Figures 3(g) Bare frame With \backslash -Bracing System, 3(h) Bare frame With $/$ -Bracing System, 3(i) Bare frame with Λ -Bracing System, 3(j) Bare frame With V-Bracing System 3(k) Bare frame with X-Bracing System, 3(l) Shear Wall at Corner With X-Bracing System

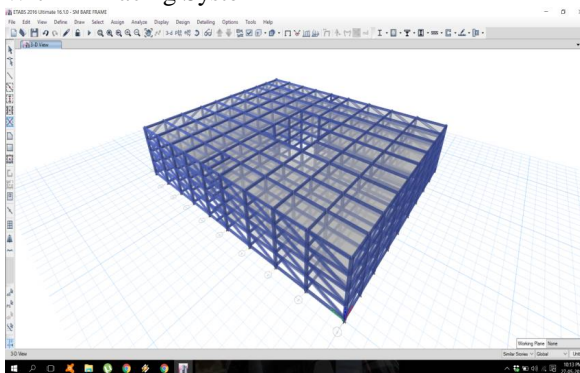


Figure 3(g)

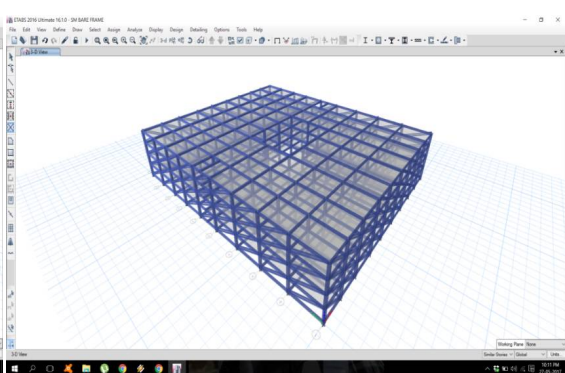


Figure 3(h)

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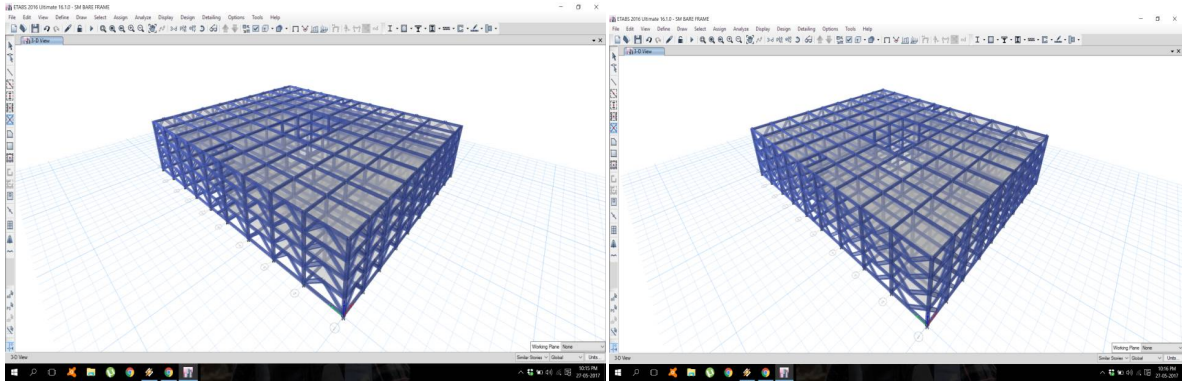


Figure 3(i)

Figure 3(j)

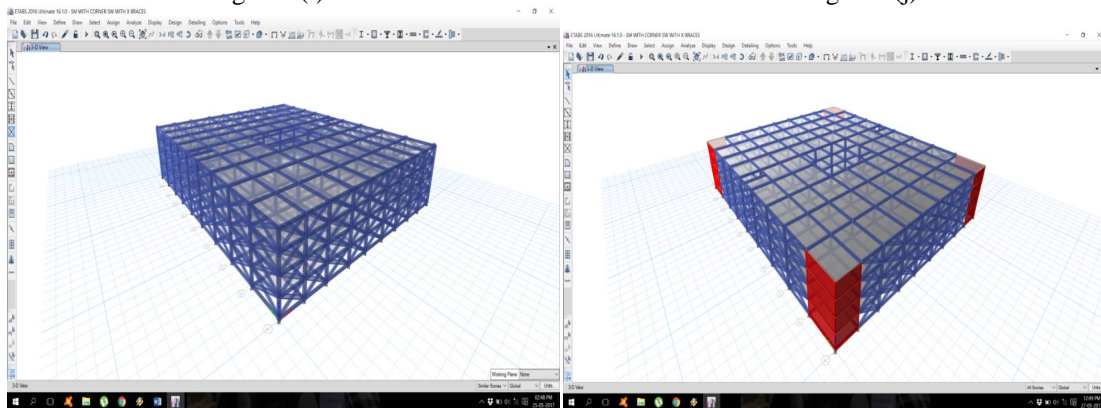


Figure 3(k)

Figure 3(l)

IV. EXPERIMENTAL RESULTS

The following table (1) represents the displacements obtained for different types of bracings along with bare frame at different storey levels.

STOREY	DISPLACEMENT IN mm						
	MODEL 1 BARE FRAME	MODEL 2 BRACE 1(/)	MODEL3 2(/)	BRACE	MODEL 4 BRACE 3(/)	MODEL 5 BRACE 4(V)	MODEL 6 BRACE 5(X)
4	1.181	0.907	0.853		0.796	0.701	0.445
3	0.975	0.694	0.582		0.476	0.408	0.381
2	0.718	0.485	0.344		0.341	0.197	0.191
1	0.345	0.246	0.173		0.139	0.052	0.046

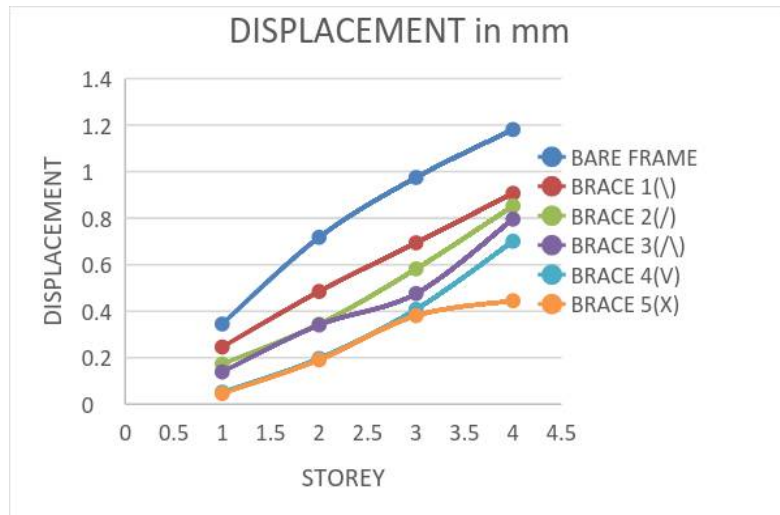
Table 1: Displacement of Bracing system

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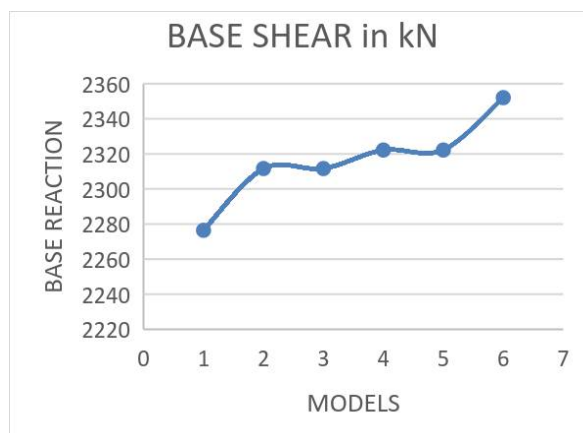


Graph 1: Displacement of Bracing System

The following table (2) represents the base shear values obtained for different types of bracings along with bare frame.

BASE SHEAR IN kN					
MODEL 1 BARE FRAME	MODEL 2 BRACE 1(\)	MODEL 3 BRACE 2(/)	MODEL 4 BRACE 3(\^)	MODEL 5 BRACE 4(V)	MODEL 6 BRACE 5(X)
2276.42	2311.63	2311.62	2322.17	2322.17	2352.04

Table 2: Base Shear of Bracing System



Graph 2: Base Shear of Bracing System

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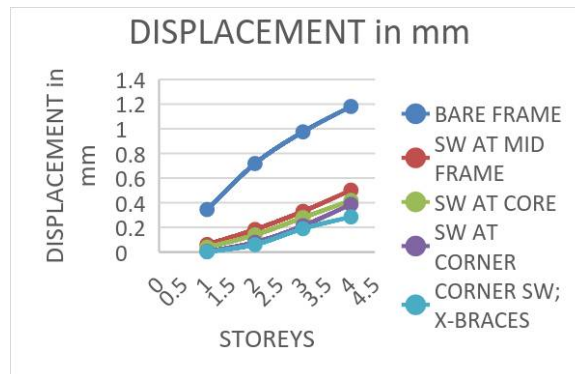
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The following table (3) represents the displacements obtained for shear walls provided at different locations along with bare frame at different storey levels

DISPLACEMENT IN mm					
STOREY	MODEL 1 BARE FRAME	MODEL 2 SW AT MID FRAME	MODEL 3 SW AT CORE	MODEL 4 SW AT CORNER	MODEL 5 SW AT CORNER WITH X-BRACE
1	0.345	0.061	0.039	0.005	0.0025
2	0.718	0.183	0.139	0.079	0.060
3	0.975	0.330	0.279	0.213	0.190
4	1.181	0.502	0.419	0.387	0.285

Table 3: Displacements of Shear Wall



Graph 3: Displacements of Shear Wall

The following table (4) represents the base shear obtained for shear walls provided at different locations along with bare frame.

BASE SHEAR IN kN				
MODEL 1 BARE FRAME	MODEL 2 SW AT MID FRAME	MODEL 3 SW AT CORE	MODEL 4 SW AT CORNER	MODEL 5 SW AT CORNER WITH X- BRACE
2276.42	2314.86	2302.98	2336.59	2423.38

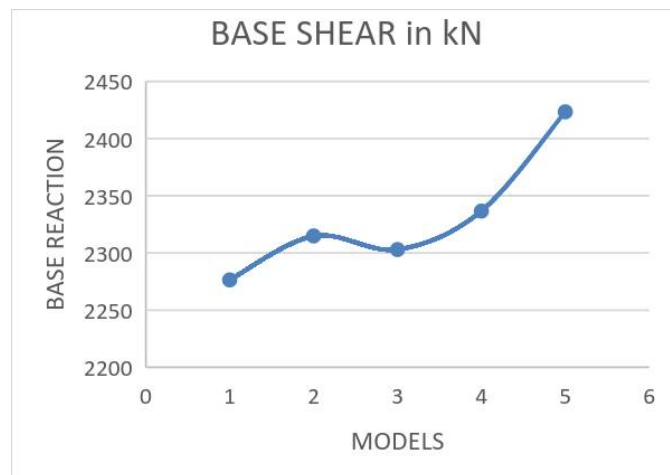
Table 4: Base Shear of Shear Wall

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Graph 4: Base Shear of Shear Wall

IV. CONCLUSIONS

1. It has been found that the base shear values is maximum in case of shear walls and bracing systems as compare to bare frame.
2. It is observed that there is increase in base shear values, when shear wall at exterior corner as compared to shear wall different locations..
3. Displacements were observed in different storeys with different Bracing system (/, \, V, X, Δ), it is clearly observed that X-bracing system showed that least displacement so, we can conclude, X-bracing system is most suitable.
4. There is a gradual decrease in the value of lateral forces from bottom floor to top floor in equivalent static method.
5. By analysing different models, we have concluded that the shear wall at exterior corner of the building gave better performance and in different systems, X-bracing system is more suitable.
6. Both combination of shear wall at exterior corner with X-bracing gives the maximum base shear and lesser displacement and storey drift.

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