

## Seismic Behavior of L-Shape RC Building and Effect of Shearwall

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### Abstract

As the need and demand of the new generation and increasing population has made the architects or engineers forces towards the planning of structure having irregular plan configurations. It is necessary to identify the performance of such structures to withstand against lateral load due to earthquakes. In the current study, the analysis of a multi-storeyed RC building of L-shape having G+8 Storey in medium soil is carried out with Equivalent Static Analysis in Staad.pro Advanced Connect edition Software. Also this study is carried out the effect of shear walls to improve the performance of building during the earthquake. The equivalent static analysis gives the same value of Base shear & Time period in X, Z direction in both cases. Joint displacement at the corner of the building is found less in building with shear walls.

### Keywords

Re-entrant Corners, Staad.pro Connect Edition, Equivalent Static Analysis

### Introduction

The buildings that have been significantly damaged during past earthquakes have shown that the dynamic behaviour of structures is affected to a great extent by its shape, dimensions, and location of structural elements. [1,11] Issues with respect to architect are frequent on structural demand to design earthquake-resistant buildings. The buildings with regular geometry and uniformly distributed mass and stiffness in the plan as well as in elevation suffer much less damage compared to irregular configurations. [12,13] But nowadays the Presence of re-entrant corners in the floor plan is one such irregularity. But these types of building configurations give functional, ventilation and spatial advantages. L,H,C and + are Irregular floor plan which is commonly used for public buildings (such as hotels, schools, hostels, apartments) in urban areas because they provide more no. of perimeter rooms with proper ventilation as well as open areas which can be used as parks, playgrounds, assembly areas. [3,11] If building is irregular, then excessive stresses or forces get developed in a certain portion and they cause serious damages. [7,14]

### Methodology

- The analysis of a multi-storeyed RC building having G+8 Storey in medium soil is carried out with Equivalent Static Analysis in Staad.pro Advanced Connect edition Software.
- Building having L shape is taken into consideration.
- To study effect of shear walls to improve performance of building during earthquake [2, 10].
- To study seismic behavior.[4,5]
- To compare the responses of structures for base shear, Time period, Maximum displacement, Joint displacement and Support reactions.[6]

### General Specifications: [8,9,10]

- Re-entrant corner in L shape. Both projections provided are 75% & 66.67% in X-direction and Y-direction respectively.
- No of bays in X direction: 8, No of bays in Y direction : 6
- Size of bay: 5 m x 5 m.
- Earthquake Zone: V
- Grade of Concrete: M 25, Grade of Steel : Fe 500
- Height of each storey: 3 m, Number of storey : 8
- Live load on floors: 2 kN/m<sup>2</sup>
- Floor Finishes: 1 kN/m<sup>2</sup>
- Beam size: 230 mm x 500 mm, Column size : 300 mm x 600 mm
- Slab thickness: 150 mm, Shear wall thickness : 230 mm
- Soil Types: Type II (Medium Soil)
- Importance factor: 1.2 (Residential or commercial buildings)

- Response reduction factor (RF): 5 (RC building with SMRF)
- Damping: 0.05 % (RC building)

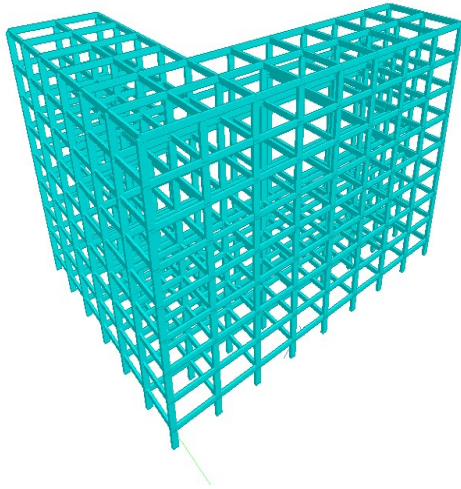


Figure 1: L Shape Bare Frame

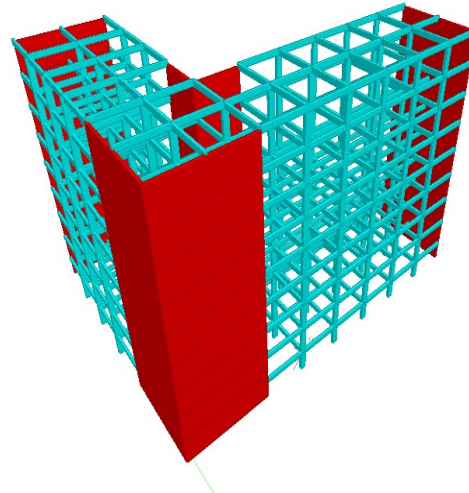


Figure 2: L Shape Frame with Shear Wall

**Results and Discussion**

S.N.		L-SHAPE BARE FRAME	L-SHAPE WITH SHEAR WALL
1	TIME PERIOD	0.86356 sec	0.86356 sec
2	SA/G AS PER IS 1893	0.001	0.001
3	LOAD FACTOR	1.000	1.000
4	VB AS PER IS 1893	1779.97 KN	1779.97 KN
5	VB Act Based on clause 7.2.1	1779.97 KN	1779.97 KN
6	VB Min Based on clause 7.2.2	753.48 KN	753.48 KN

**Table 1: Base Shear and Time Period in X & Z**

Table No. 1 shows Base Shear and Time Period for L-shape building with and without shear wall in X & Z direction.

	L-SHAPE BARE FRAME		L-SHAPE WITH SHEAR WALL	
	EQX	EQZ	EQX	EQZ
X	2.62191E+00	2.70580E-01	8.82314E+00	6.89923E-01
Y	-3.72611E-02	3.68996E-02	-4.21292E-01	5.46633E-01
Z	2.92544E-01	4.00772E+00	7.17206E-01	9.40788E+00
RX	1.24510E-04	2.06681E-03	-9.27276E-04	1.76482E-03
RY	-4.51176E-04	-5.11950E-04	-2.02686E-02	-1.97902E-02
RZ	-1.66115E-03	-1.44112E-04	-1.49592E-03	1.13268E-03

**Table 2: Maximum Displacements for Load Type EQX & EQZ in CM**

Table No. 2 shows maximum displacements for L-shape building with and without shear wall for load type EQX and EQZ in centimeters.

Following Table No. 3 & Table No. 4 Showing Joint Displacement (cm) at Top-Most Corner of Building

X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
2.5407	-0.2441	-0.2595	-0.0006	-0.0005	-0.0004
2.5056	-0.3248	0.4257	-0.0006	-0.0006	0.0002
3.9396	-0.2301	-0.2373	0.0006	-0.0003	-0.0004
3.1287	-0.6198	0.0177	0.0004	-0.0004	0.0002
3.1055	-0.3195	0.4323	0.0006	-0.0004	0.0003
3.9311	-0.3385	0.0315	0.0006	-0.0002	0.0001

**Table 3 : For L-Shape Bare Frame**

X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
0.4533	0.0219	-0.2964	-0.0003	-0.0008	-0.0003
0.4256	-0.0728	0.0278	0.0000	-0.0008	0.0004
0.2433	-0.0098	-0.2701	0.0002	0.0004	0.0000
1.6277	0.0041	-0.6759	0.0002	-0.0006	0.0001
1.5532	-0.0625	0.0220	-0.0000	-0.0013	0.0003
0.2484	-0.1241	-0.6833	0.0002	0.0016	-0.0000

**Table 4: For L-Shape with Shear Wall**

Following Table No. 5 and Table No. 6 Showing Support Reactions (kN) & Moments (kN-m) at Corners of the Building.

FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM-Z
54.46	962.21	-11.75	-9.67	-1.09	-112.60
32.65	613.27	-5.28	0.12	-1.19	-99.38
73.83	1027.07	7.04	2.51	-0.32	-163.23
73.37	1721.64	6.40	4.31	-0.28	-150.51
47.23	611.18	13.24	12.07	-0.58	-134.23
52.53	540.74	9.63	6.40	-0.24	-150.72

**Table 5: For L-Shape Bare Frame**

FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM-Z
262.65	2317.48	-127.14	823.39	-1.39	694.43
-1.64	548.77	-57.87	410.67	-0.01	-5.05
153.40	1062.22	0.56	1.00	-0.43	693.73
284.99	2401.30	-145.93	404.75	1.07	267.64
3.12	661.16	79.77	-472.67	3.70	-15.49
19.32	118.38	-0.30	-0.90	-0.22	-167.37

**Table 6: For L-shape with Shear Wall**

### Conclusion

1. The equivalent static analysis gives the same value of Base shear & Time period in X, Z direction in both models.
2. Joint displacement at the corner of the building is found less in building with shear walls.
3. The values of reaction at corner supports of buildings are comparatively higher in building with shear walls.
4. In a building with the shear wall, the maximum displacement is observed in the lower part of the corner columns and in a building having bare frame it is observed in upper part of the corner columns.

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