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Comparison Between Different Shapes of Structure By Time History Method of Dynamic Analysis

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Abstract-The time history analysis is performed on two different shapes of structure by using STAAD PRO. And the comparison results are studied and compared accounting for the earthquake characteristics and the structure dynamic characteristics. As the results show that the earthquake response peak values and the main response frequencies are very close and comparable, it can be referred to by the engineering applications.

Keywords Time history analysis, Structure Dynamic Characteristics, Earthquake response peak values, STAAD PRO

1. Introduction

In almost all seismic design codes consideration of the simultaneous effect of two horizontal components of earthquake excitation is taken into account as per Bureau of Indian standard. The design lateral force shall be considered in each of two orthogonal horizontal directions of the structure.

For structures which have the lateral force resisting elements in the two orthogonal directions, the design lateral force shall be considered along one direction at a time, and not in both directions simultaneously. It is known that for most world tectonic regions the ground motion can act along any horizontal direction, therefore, this implies the existence of a possible different direction of seismic incidence that would lead to an increase of structural response. Critical angles are earthquake incidence angles, producing critical responses. In this study, a four storey reinforced concrete building with moment resisting frame, of different shapes i.e., L shaped and T shaped are analysed by Time history method of Dynamic analysis of Earthquake. A set of values from 0 to 90 degrees, with an increment of 10 degrees has been used of excitation of seismic force. The details of the study and its result are described briefly in the following section of the paper.

1.1 Details of Earthquake
1.2

The 1967 Koynanagar earthquake occurred near Koynanagar town in Maharashtra, India on 11 December. The 6.5 magnitude shock hit near the site of Koyna dam and claimed at least 180 lives and injured over 1,500. More than 80% of the houses were damaged in KoynaNagar Township, but it didn't cause any major damage to the dam except some cracks which were quickly repaired. There have been several earthquakes of smaller magnitude there since 1967. The deadly earthquake caused a 10ï 15 cm (3.9ï 5.9 in) fissure in the ground which spread over a length of 25 kilometers (16 mi).

Some geologists believe that the earthquake was due to reservoir-triggered seismic activity. Senior project officials have repeatedly denied this conclusion.

Date of Earthquake: 11th December 1967
Magnitude: 6.5
Epicenter: 17o24ôN 73o46ôE
Areas Affected: India
Casualties: 180

2. Parametric Details of Model

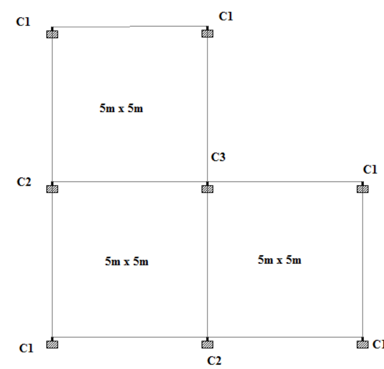

Figure 1: L Structure

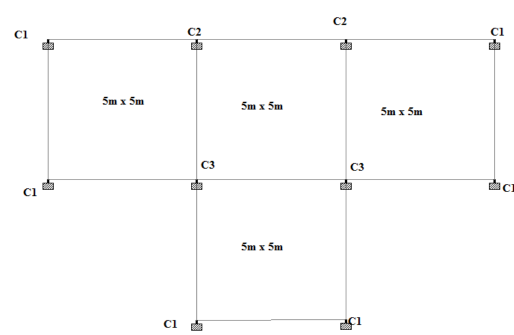

Figure 2: T Structure

The position of three different types of columns C1, C2, C3 i.e. corner, side and middle respectively ofconsidered structure is shown in figure 1 and 2. And table 1 represents all the basic specification required for the analysis of the structure.

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Table 1: Specification of Models

Type of Structure	G+4 storied Rigid Jointed frame (RC Moment Resisting Frame)
Seismic Zone	V, As per IS 1893 Part I, Z=0.36
Importance Factor	For all general buildings = 1
Rock and Hard soil Site Factor	Hard Soil = 1
Damping Ratio	0.05
Imposed load	2 kN/m2
Storey Height	3.15m
Specific weight of RCC	25 kN/m3
Specific weight of brick Infill	18 kN/m3
Infill wall	150mm
Corner Columns size C1	230 x 380 mm
Side Columns size C2	300 x 380 mm
Middle Columns size C3	X 450 mm

3. Methodology

The present study undertaken deals with time history method of dynamic analysis. Time history is available only for X direction, so in order to apply forces in different angles, the structure has to be rotated with incidence angle from 0 to 90 degrees, with an increment of 10 degrees and column forces have been investigated in all cases. Further in order to find the accurate angle the interval of one degree is used. The columns have been divided into three main categories, including corner, side and internal (middle) columns and the results are compared.

4. Results And Discussion

L Structure
Time History Method

Table 2 a: L STRUCTURE CORNER COLUMNC1

ANGLE	SHEAR +	SHEAR-	My	Mz
0	801.92	84.815	21.504	55.231
10	795.013	85.818	23.669	54.576
20	797.32	89.046	25.986	53.626
30	797.182	89.178	28.989	51.013
40	792.962	85.526	32.348	47.029
50	785.236	78.43	35.064	43.416
60	775.381	68.971	36.741	39.392
70	766.641	58.363	37.406	35.164
80	767.044	50.154	37.533	31.432
90	767.718	51.439	37.503	30.473

Table 2 b: L Structure Side Column C2

ANGLE	SHEAR+	SHEAR-	My	Mz
0	1310	0.368	31.504	73.704
10	1310	12.056	33.026	73.078
20	1310	22.846	36.369	71.051
30	1310	34.259	40.321	67.534
40	1280	48.991	45.78	63.734
50	1270	62.034	50.429	60.893
60	1250	70.969	53.461	57.792
70	1230	75.751	54.905	54.522
80	1220	77.855	55.406	51.125
90	1220	78.475	55.534	47.688

Table 2 c: L Structure Middle Column C3

ANGLE	SHEAR+	SHEAR-	My	Mz
0	1670	39.082	17.869	83.772
10	1670	34.316	20.695	77.552
20	1660	28.936	33.322	73.278
30	1660	23.493	41.108	67.459
40	1660	25.175	42.45	59.443
50	1660	18.899	40.173	49.954
60	1660	19.757	44.817	39.656
70	1660	19.898	47.265	28.986
80	1660	12.25	48.092	18.278
90	1660	12.088	48.125	10.819

T Structure
Time History Method

Table 3 a: T STRUCTURE CORNER COLUMN C1

ANGLE	SHEAR +	SHEAR -	My	Mz
0	829.71	82.065	22.566	57.626
10	835.165	86.819	29.23	58.209
20	838.397	89.92	30.789	58.316
30	837.921	89.94	29.809	56.242
40	832.946	85.891	31.184	52.047
50	824.182	78.061	33.713	47.933
60	813.394	67.761	35.118	43.486
70	802.318	56.619	35.601	37.49
80	793.625	48.747	35.636	32.68
90	793.329	47.977	35.642	29.684

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Table 3 b: T Structure Side Column C2

ANGLE	SHEAR +	SHEAR -	My	Mz
0	1190	1.867	38.995	57.565
10	1200	4.822	41.139	55.915
20	1210	9.708	43.441	53.08
30	1220	13.961	45.522	49.326
40	1240	18.59	47.341	43.493
50	1250	23.441	48.86	36.874
60	1260	26.778	51.633	31.11
70	1260	45.764	52.922	22.902
80	1260	66.789	53.463	12.035
90	1260	76.961	53.786	1.918

Table 3 C: T Structure Middle Column C3

ANGLE	SHEAR +	SHEAR -	My	Mz
0	1750	41.067	11.624	82.225
10	1760	44.919	20.746	81.602
20	1760	47.484	36.544	76.412
30	1760	48.001	45.387	69.215
40	1760	46.215	45.081	61.679
50	1750	42.619	40.42	52.241
60	1750	38.043	44.936	41.363
70	1740	33.137	46.523	33.602
80	1740	30.411	46.586	27.988
90	1740	2.204	46.186	22.409

L Structure
Time History Method
Column C1 (Corner Column)

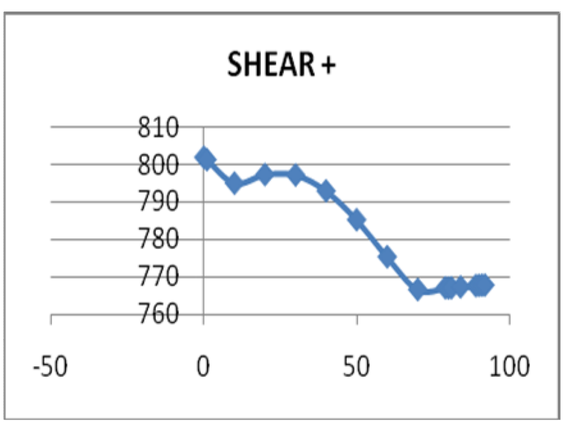

Figure 3 a: Graph of Fx v/s Angle of Rotation in degrees

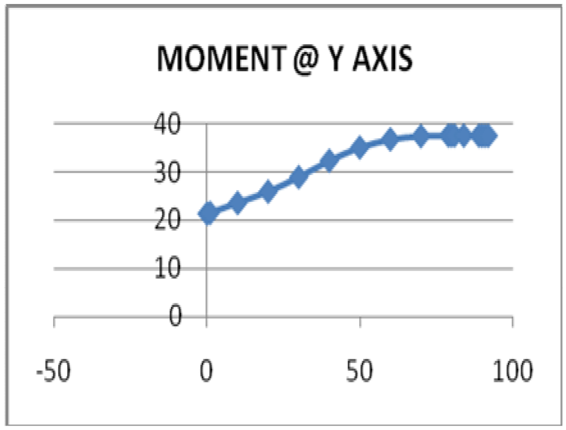

Figure 3 b: Graph of My v/s Angle of Rotation in degrees

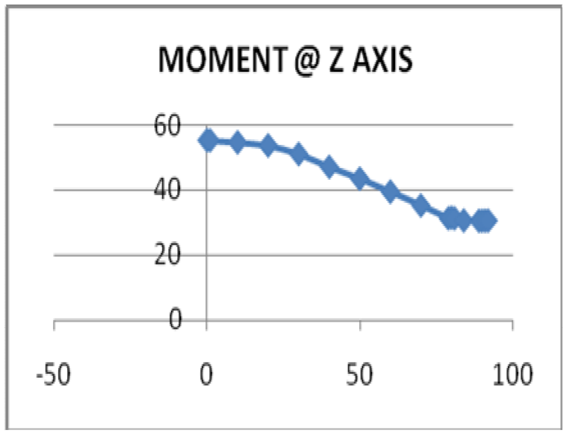

Figure 3 c: Graph of Mz v/s Angle of Rotation in degrees

T Structure
Time History Method
Column C1 (Corner Column)

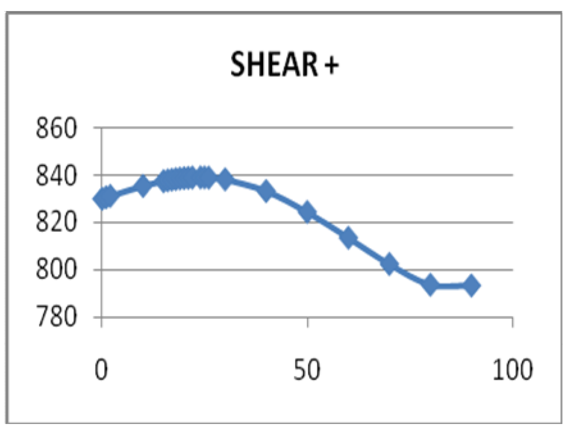

Figure 4 a: Graph of Fx v/s Angle of Rotation in degrees

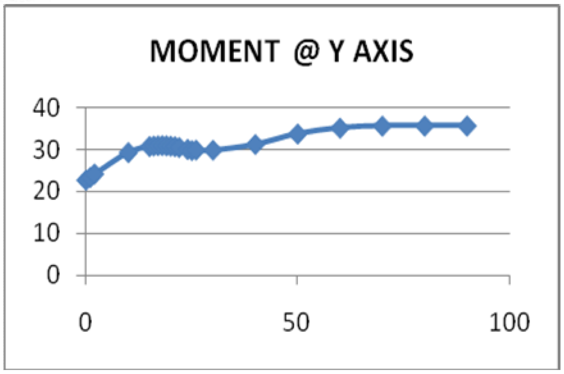

Figure 4 b: Graph of My v/s Angle of Rotation in degrees

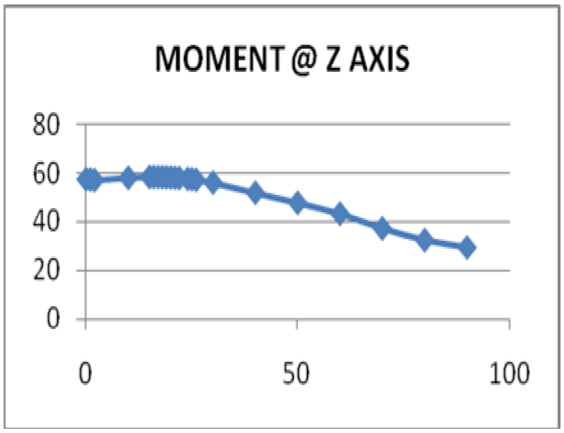

Figure 4 c: Graph of Mz v/s Angle of Rotation in degrees

L Structure
Time History Method
Column C2 (Side Column)

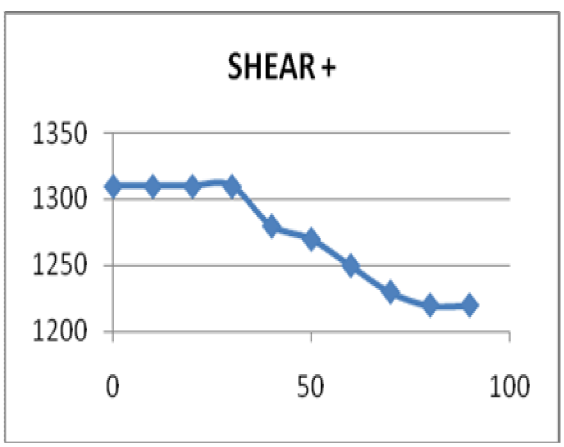

Figure 5 a: Graph of Fx v/s Angle of Rotation in degrees

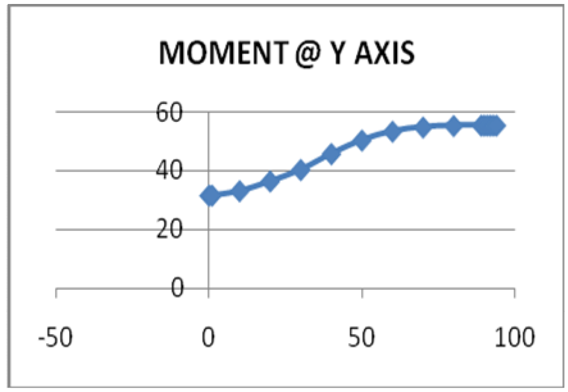

Figure 5 b: Graph of My v/s Angle of Rotation in degrees

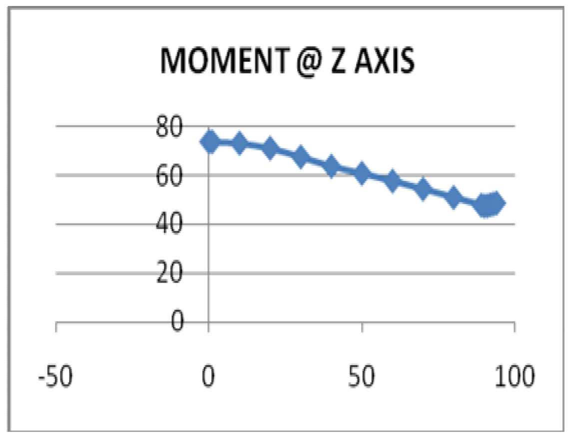

Figure 5 c: Graph of Mz v/s Angle of Rotation in degrees

T Structure
Time History Method
Column C2 (Side Column)

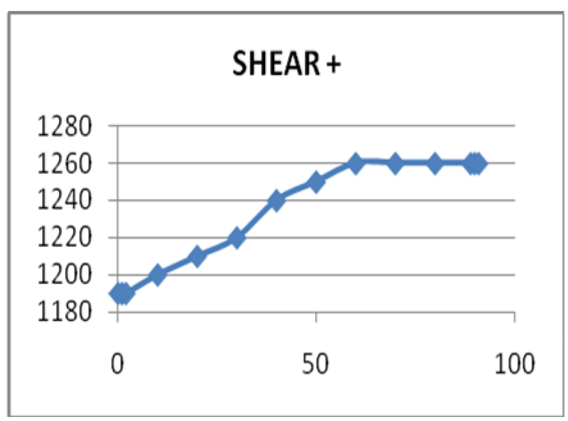

Figure 6 a: Graph of Fx v/s Angle of Rotation in degrees

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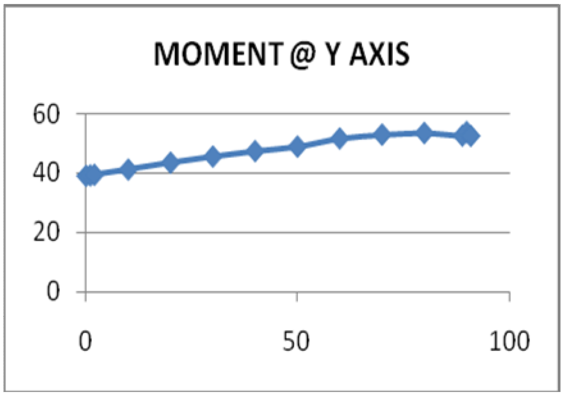

Figure 6 b: Graph of My v/s Angle of Rotation in degrees

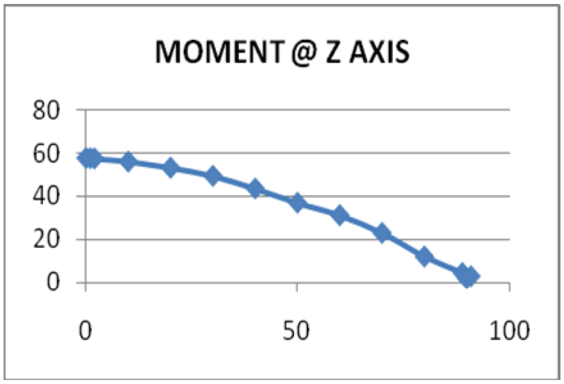

Figure 6 c: Graph of Mz v/s Angle of Rotation in degrees

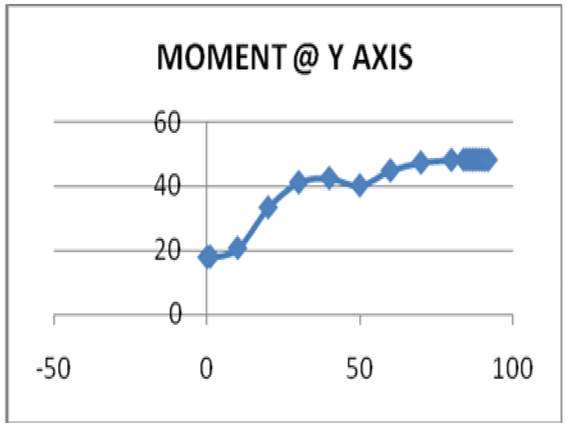

Figure 7 b: Graph of My v/s Angle of Rotation in degrees

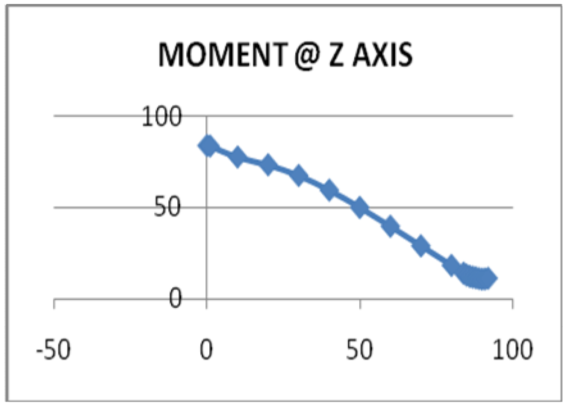

Figure 7 c: Graph of Mz v/s Angle of Rotation in degrees

L Structure
Time History Method
Column C3 (Middle Column)

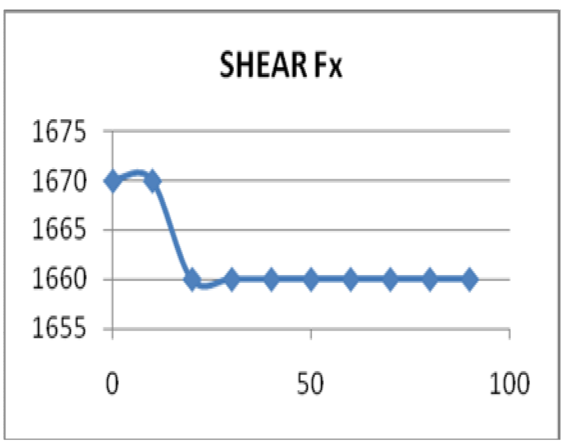

Figure 7 a: Graph of Fx v/s Angle of Rotation in degrees

T Structure
Time History Method
Column C3 (Middle Column)

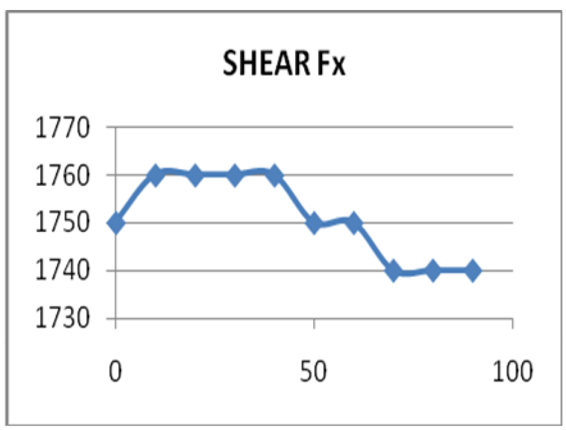

Figure 8 a: Graph of Fx v/s Angle of Rotation in degrees

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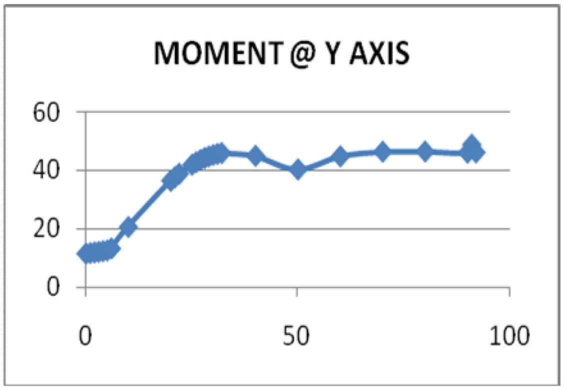

Figure 7 b: Graph of My v/s Angle of Rotation in degrees

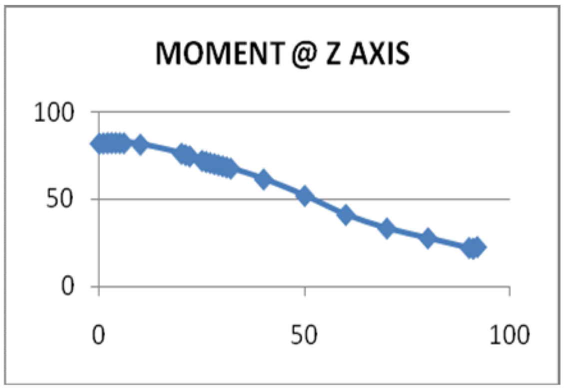

Figure 8 c: Graph of Mz v/s Angle of Rotation in degrees

5. Conclusion

1. For Corner Column C1: The shear force in X direction i.e. Fx is decreasing throughout from 0 to 90 degrees, it has maximum value at 0 degree for L structure whereas T structure also shows parabolic decreasing curve for Fx and attains maximum value at 20 degrees.
2. Moment about Y axis for corner column C1 of L structure attains maximum value at 80 degrees and Moment about Z axis attains maximum at 0 degrees whereas T structure attains maximum value at 90 degrees for My and for Mz at 20 degrees
3. For Side Column C2: Shear force Fx is constant from 0 to 30 degrees and then it decreases till 90 degrees for L structure whereas for T structure the curve is continuously increasing i.e. minimum value at 0 degree and maximum at 90 degrees.
4. L and T structure both attains maximum My at 90 degrees and Mz at 0 degrees.
5. For Middle Column C3: For L structure the shear force Fx at start increases slowly and shows a steep slope and from 20 degrees onwards it is constant throughout. T structure shows a different nature as shown in figure No. 8a.
6. Value of My i.e Moment about Y axis is maximum at 90 degrees for L structure and 80 degrees for T shaped structure.
7. Value of Mzi.e Moment about Z axis is maximum at 0 degrees for L and T shaped structure.
8. From the above graphs and conclusions it can be concluded that T shaped structure has to resist more shear force than L shaped structure.

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