"ANALYSIS AND DESIGN OF A PENTAGONAL SHAPED PEB STRUCTURE WITH INCLINED COLUMN"

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Abstract : This study has been undertaken to analyze and design of pentagonal shaped PEB structure with inclined column under dead loads, live loads and seismic load as per IS 800:2007. In India where around 2% of nations Gross Domestic Product is contributed by the steel industry, use of steel will help in boosting country economy. Steel buildings are nearly zero energy buildings and economical. As with the development of all sectors to improve economy one basic need for all is buildings, for which mostly boxed shaped buildings are preferred . So rather than approaching a box shape building this paper will deal with a pentagon shaped structure in plan.

***IndexTerms* – PEB, Pentagon, inclined column, irregular shape.**

I. INTRODUCTION

As steel industry is growing rapidly almost all around the world. In India where around 2% of country's GDP is contributed by the steel industry, use of steel will help in boosting country economy. Steel is a material with high strength carrying capacity compare to weight ratio and reliable to use in construction with its various advantages as it boosts in the economic growth of country. Currently most of warehouses and industry where long span column free structures are required Pre-engineered buildings are used. Steel buildings are nearly zero energy buildings and economical. And it requires less time in construction, as structural components are pre-fabricated. As with the development of all sectors to improve economy one basic need for all is buildings, for which mostly boxed shaped buildings are preferred. So rather than approaching a box shape building this paper will deal with a pentagon shaped structure in plan. In recent years' structures are designed with irregular structures with inclined columns as an architectural feature. It effects the behaviour of structure, which effects the safety of structure. The inclined column is a column, which is not placed at right angle in the structure this are slanted or rotated at a certain angle.

II. REASERCH METHODOLOGY

The present chapter deals with the working procedure of the finite element computer program called STAAD.Pro . Also this chapter deals with modelling of pentagonal shaped PEB structure with inclined columns subjected to dead load, live load and seismic load. The behavior of structure under different loading is studied using post processing commands and various results are studied for different type of loadings.

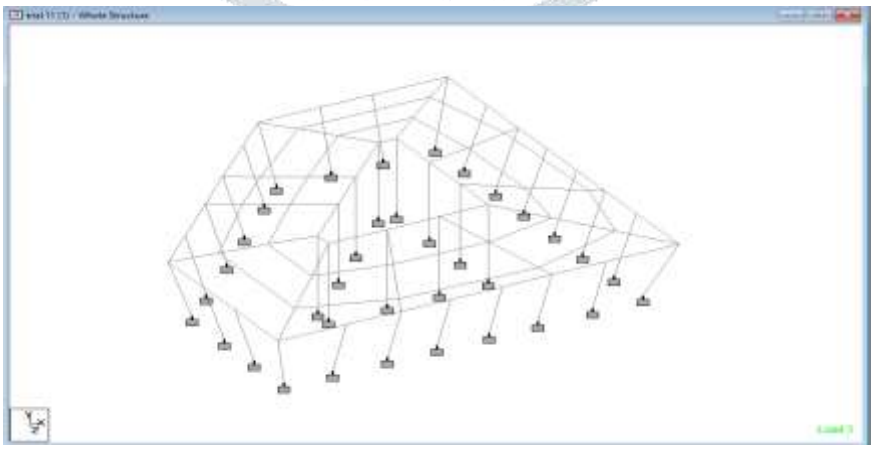

Fig.1.1 shows model in STAAD. Pro

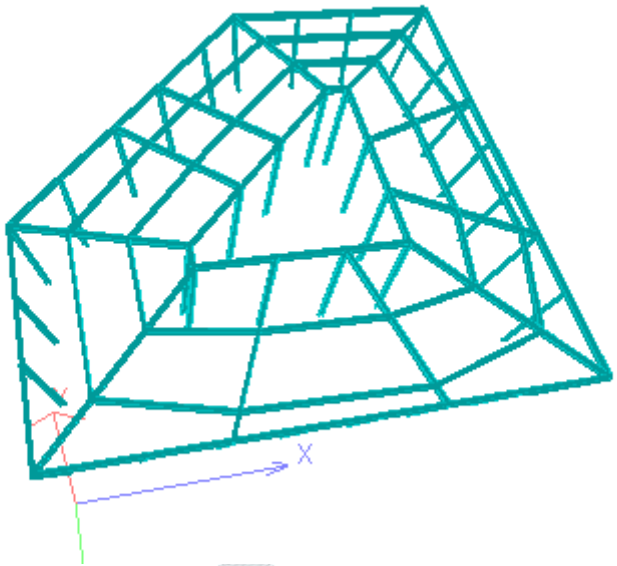

Fig.1.2 shows 3-D model in STAAD. Pro

III. BASIC DESIGN DATA

Dead Load (Rafter)
Connection weight is considered 15% of self-weight

Weight of roofing sheet – (0.47mm thick) =	5Kg/m2	
Weight of sag rod, Flange brace-	5kg/m2	
Collateral load =	10kg/m2	
Total load =	20kg/m2 =	0.2kn/m2
UDL on Main Rafter =	1.62 Kn/m	
UDL Weight due to purlin =	55.06kg/m2 =	0.55Kn/m

IV. STRUCTURAL MEMBERS

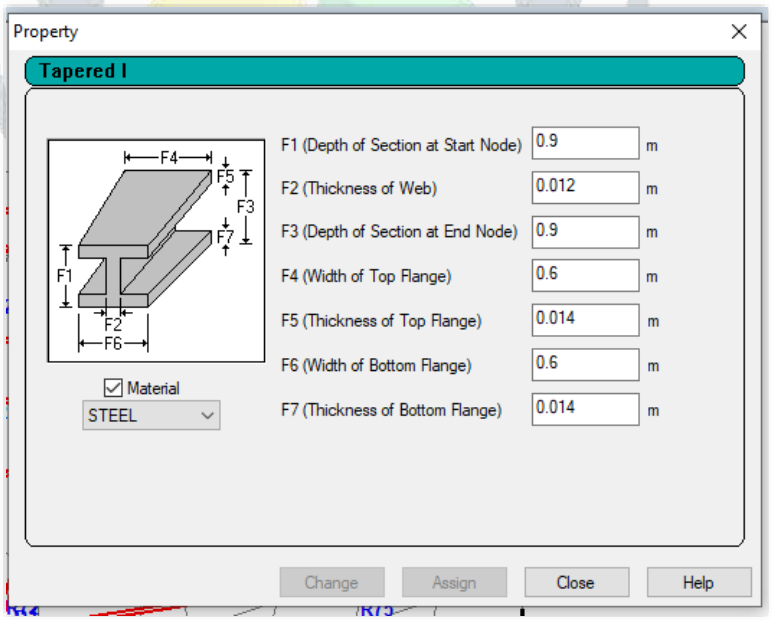

Fig.4.1 Tapered rafter section

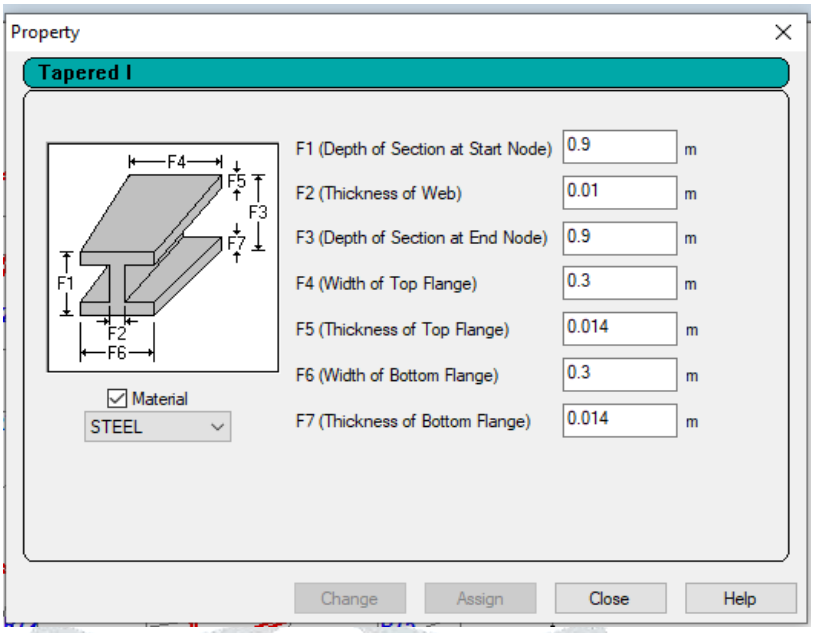

Fig.4.2 Tapered rafter section

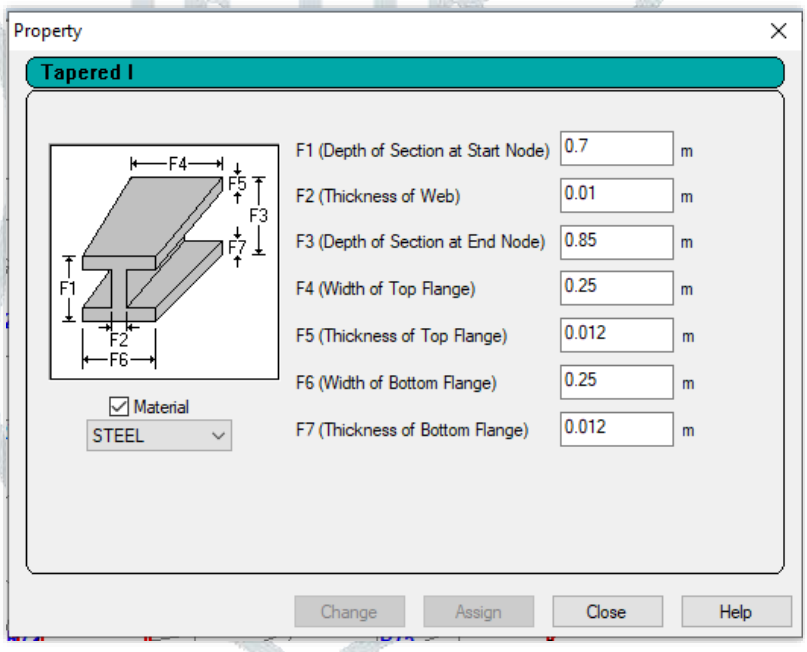

Fig.4.3 Column section

V.ANALYSIS

Following results are obtained below for analysis of structure for dead loads, live loads, Seismic forces.

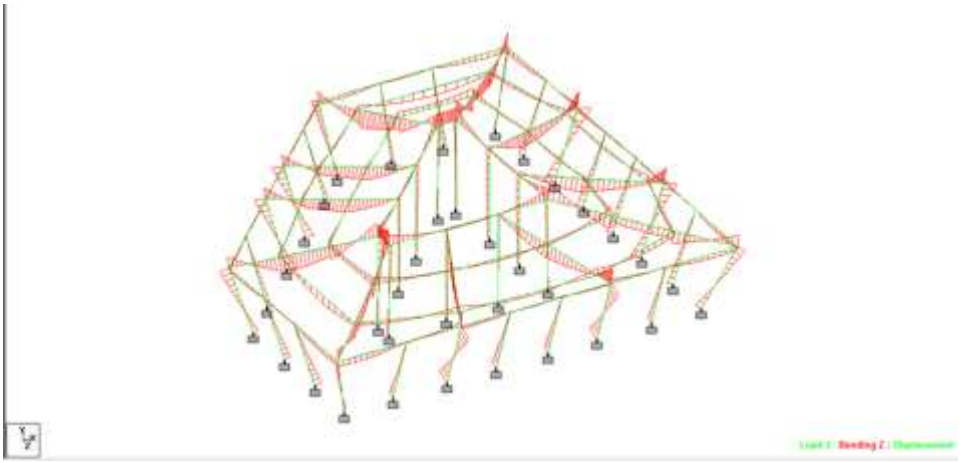

Fig.5.1 Bending Moment in Z direction

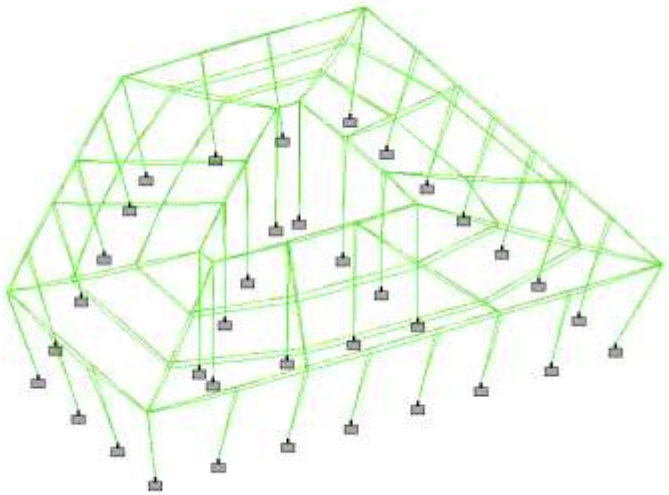

Fig.5.2 Bending Moment in Y direction

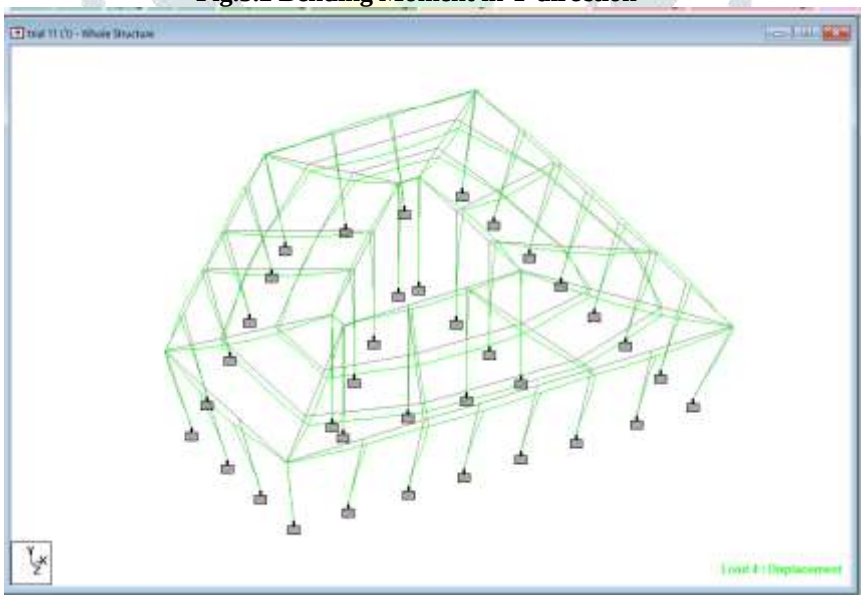

Fig.5.3 Deflection of members

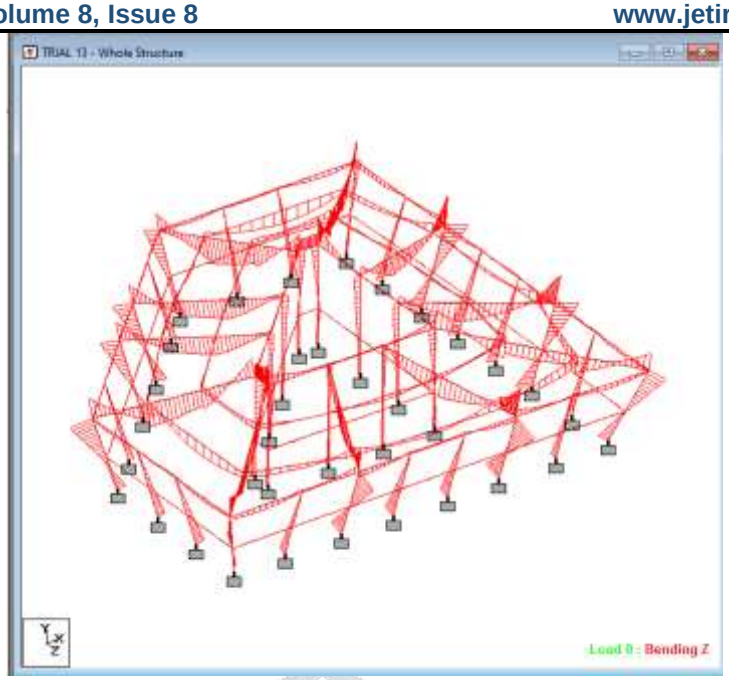

Fig.5.4 Bending in Z direction for load envelope

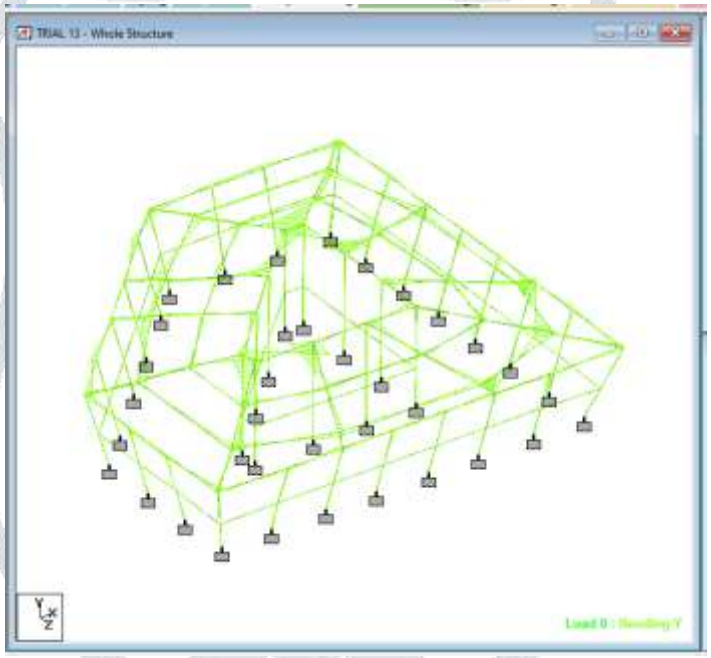

Fig.5.5 Bending in Y direction for load envelope

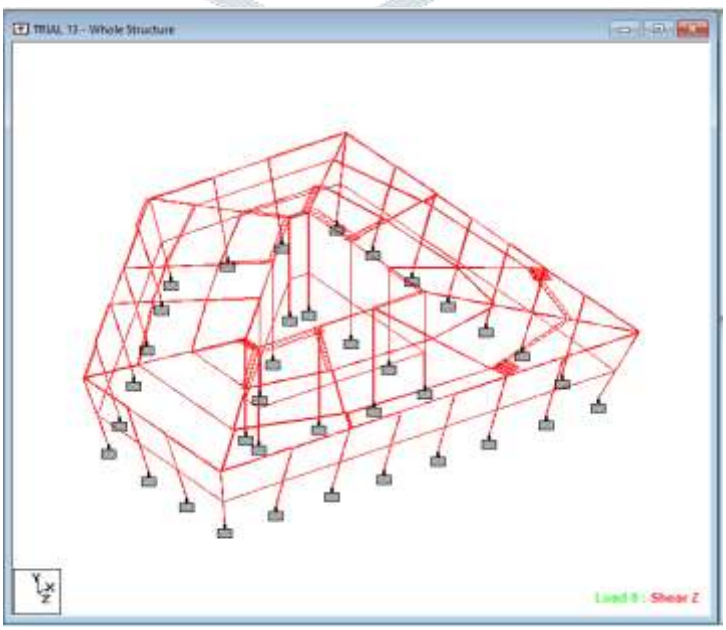

Fig.5.6 Shear force in Z direction

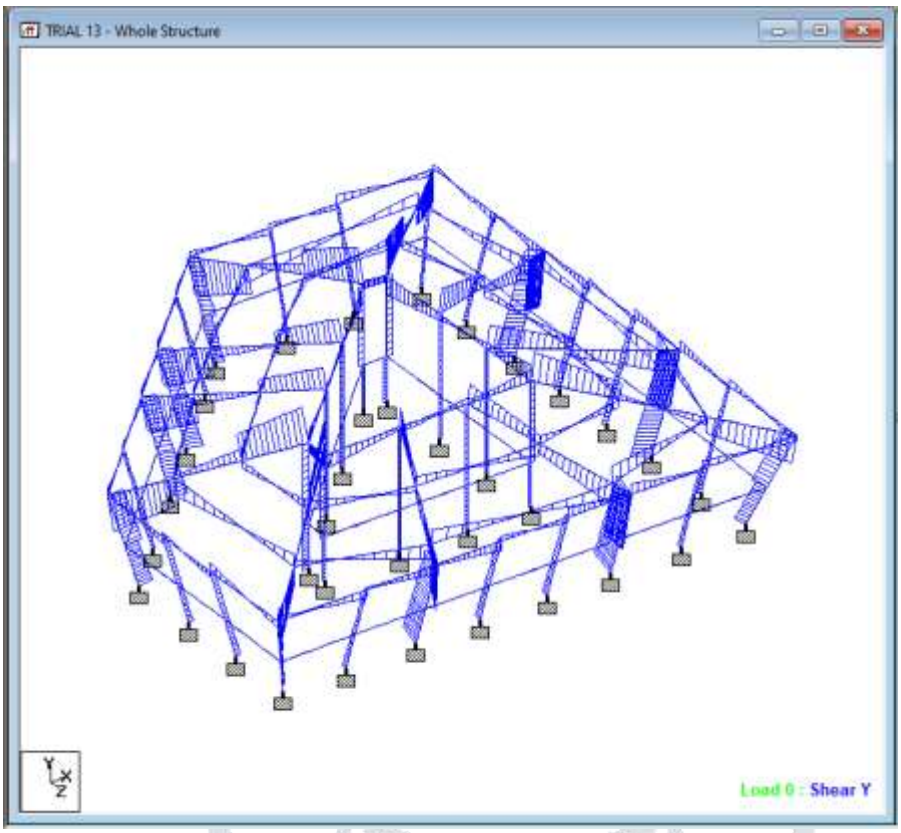

Fig.5.7 Shear force in Y direction

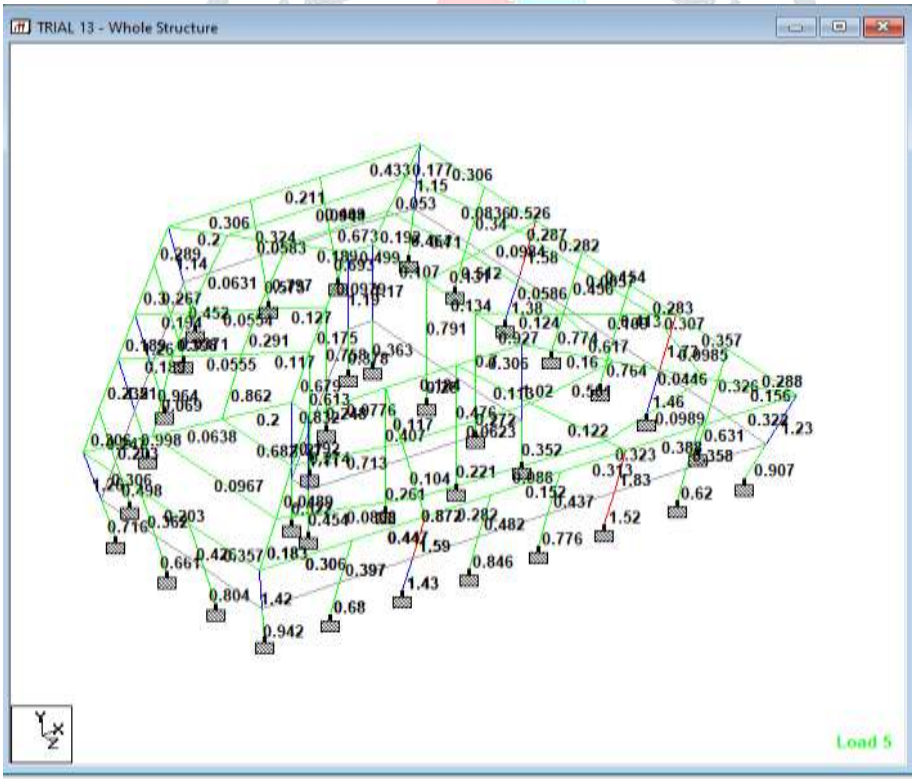

Fig.5.8 Utilization ratio

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	92	16 SER 212 1	**15.088**	-5.231	2.742	16.203	-0.000	0.000	-0.003
Min X	82	13 SER 201 1	**-17.930**	-5.670	4.841	19.419	0.000	0.001	0.003
Max Y	28	15 SER 207 1	0.166	**2.979**	12.328	12.684	0.001	-0.000	0.001
Min Y	122	13 SER 201 1	2.922	**-18.670**	5.301	19.627	-0.002	-0.000	-0.000
Max Z	107	17 SER 213 1	-0.908	-0.547	**19.047**	19.077	0.003	-0.001	-0.000
Min Z	105	13 SER 201 1	-0.297	-4.801	**-16.254**	16.951	-0.003	-0.002	-0.000
Max rX	107	13 SER 201 1	-0.265	-0.597	14.377	14.392	**0.004**	-0.001	-0.000
Min rX	105	13 SER 201 1	-0.297	-4.801	-16.254	16.951	**-0.003**	-0.002	-0.000
Max rY	106	17 SER 213 1	-0.250	-3.274	-10.952	11.434	-0.002	**0.003**	-0.000
Min rY	105	17 SER 213 1	-0.142	-4.096	-13.760	14.357	-0.002	**-0.002**	0.000
Max rZ	82	13 SER 201 1	-17.930	-5.670	4.841	19.419	0.000	0.001	**0.003**
Min rZ	92	16 SER 212 1	15.088	-5.231	2.742	16.203	-0.000	0.000	**-0.003**
Max Rs	120	17 SER 213 1	-0.094	-16.448	16.632	**23.392**	0.001	0.000	-0.000

Table no..5.1 Maximum node displacement

Allowable displacement
= 10420/180
=57.88mm therefore safe.

STEEL TAKE-OFF

PROFILE			LENGTH (METE)	WEIGHT (KN
Tapered	MembNo:	22	296.91	390.473
Tapered	MembNo:	62	361.87	757.905
Tapered	MembNo:	76	102.48	106.356
Tapered	MembNo:	80	29.28	37.140
Tapered	MembNo:	236	154.31	183.859
Tapered	MembNo:	239	37.60	54.620
ST 113.5X113.5X4.8SHS			226.53	35.291
			TOTAL =	1565.645

Table no.5.2 shows steel take off

IV. RESULTS AND DISCUSSION

1. In this the analysis and design of pentagon shaped PEB structure has been done for which the steel quantity is 159.69 metric tons.
2. The structure is heavy as the columns are not only subjected to axial loading but also to bi-axial bending.
3. Columns are also subjected to torsion moment due to inclined vertical plane.

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