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DESIGN OF A 2-STOREYED STEEL STRUCTURE WITH 20000LTR OHT ON IT USING STAADPRO SOFTWARE

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ABSTRACT

This research paper aims to Design of a 2-storeyed steel structure with 20000ltr OHT on it and find the approximate cost for its construction. At first, we assumed the basic data close to a real-life scenario. Using this data, we designed the Steel elements of this structure using StaadPro software and also referred to various IS codes, books, research papers, etc. This structure to designed to sustain various loadings, i.e., Dead Load, Live Load, Wind Load, and Earthquake loads. Various load combinations are taken into consideration to make this structure resistant to all the above loads.

Keywords: Steel Sections, Loads, Staadpro, Commercial Building, IS Codes.

I. INTRODUCTION

Nowadays, large-span, super-high, over-weight, vibration, airtight, high-rise, and light-weight engineering structures are generally steel structures. One of these segments is industrial buildings where steel structures are widely witnessed. The reason being their added advantages over the concrete structures. Steel structures can take heavy loads despite of being light weight. Also, steel structures can be fabricated easily, hence consumes less time in constructionand also has higher scrap value.

- **Structure Geometry**

The details of the geometry of structure are as follows:

- Type of structure: Commercial building
- Location: Truvandapuram
- Superstructure: Structural Steel
- Substructure: Reinforced Concrete
- Number of storey: 2
- Height of each floor: 3.6 meters
- Number of bays in longitudinal direction: 3 (5.6m,5.5m, 4.5m)
- Number of bays in lateral direction: 2 (3.7m,6.9)
- Purlin spacing: 1.5 meter
- Roofing sheet: Asbestos cement sheet
- Flooring: 6mm Steel grating
- Foundation level: 3m

- **Preliminary Drawings**

The elevation and section of structure is shown in fig-1. The column layout and the arrangement of members at different levels where the equipment rest is shown in the fig 2, fig-3, fig4 & fig-5.

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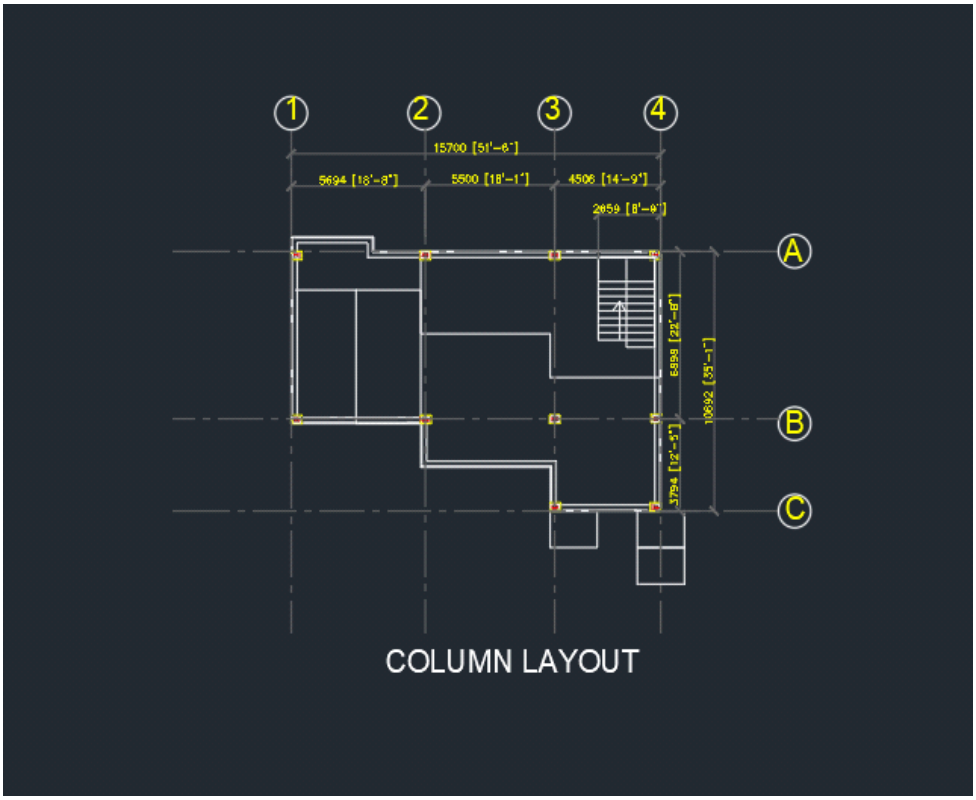

Figure 1

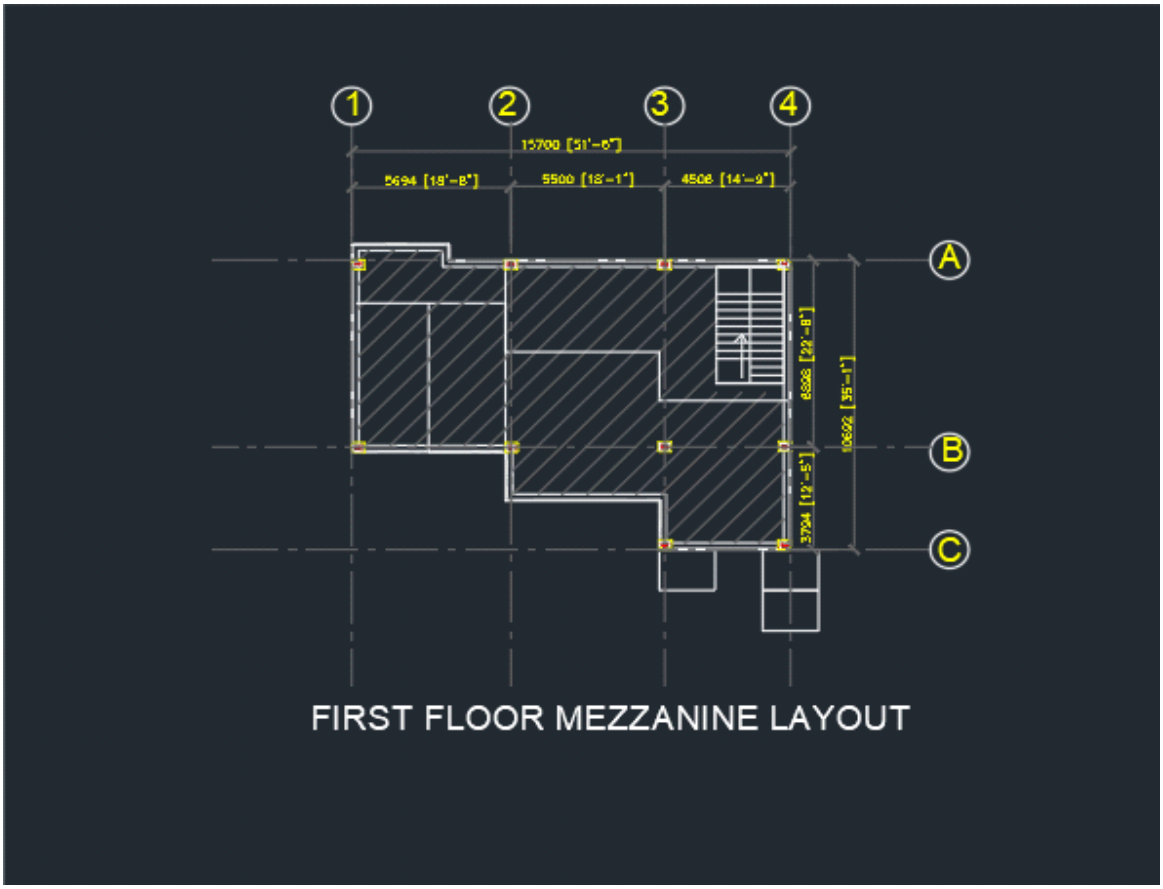

Figure 2

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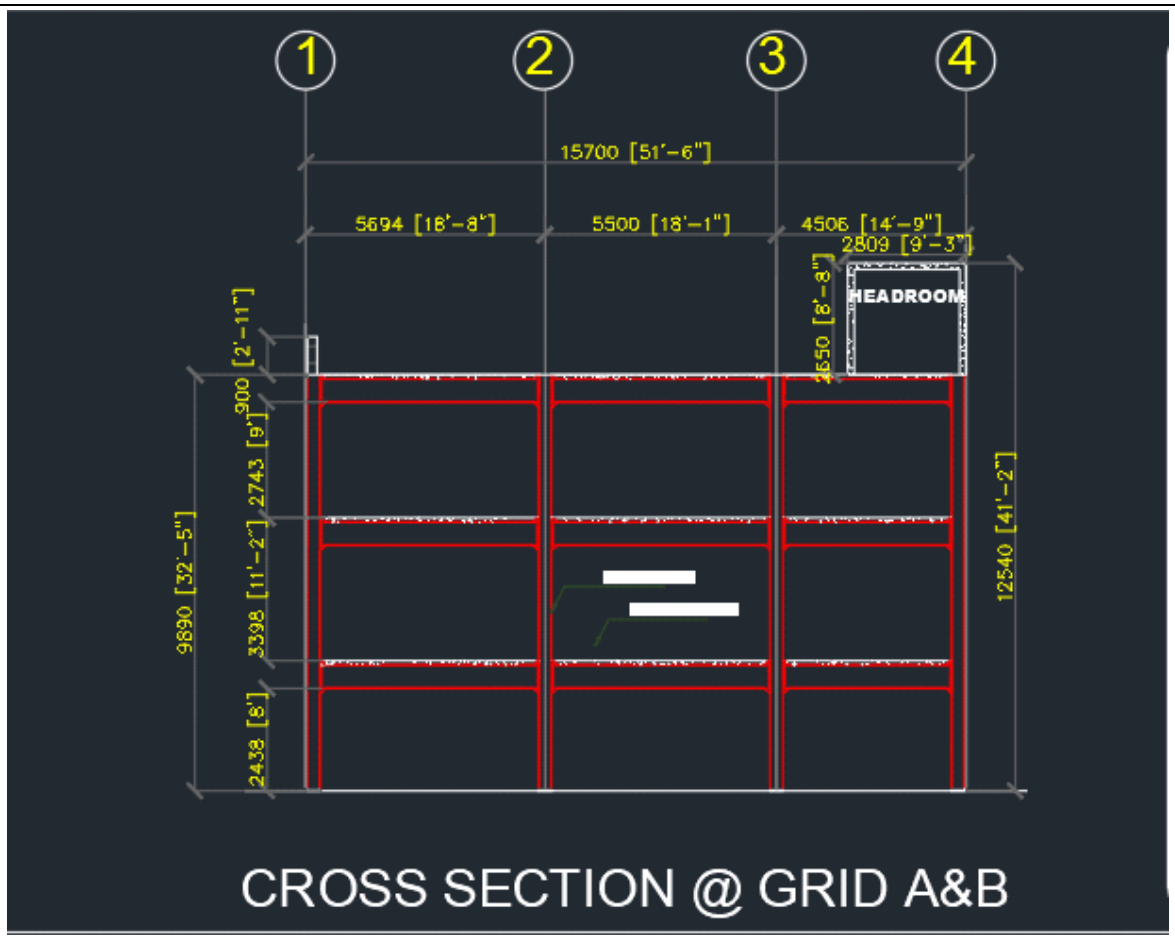

Figure 3

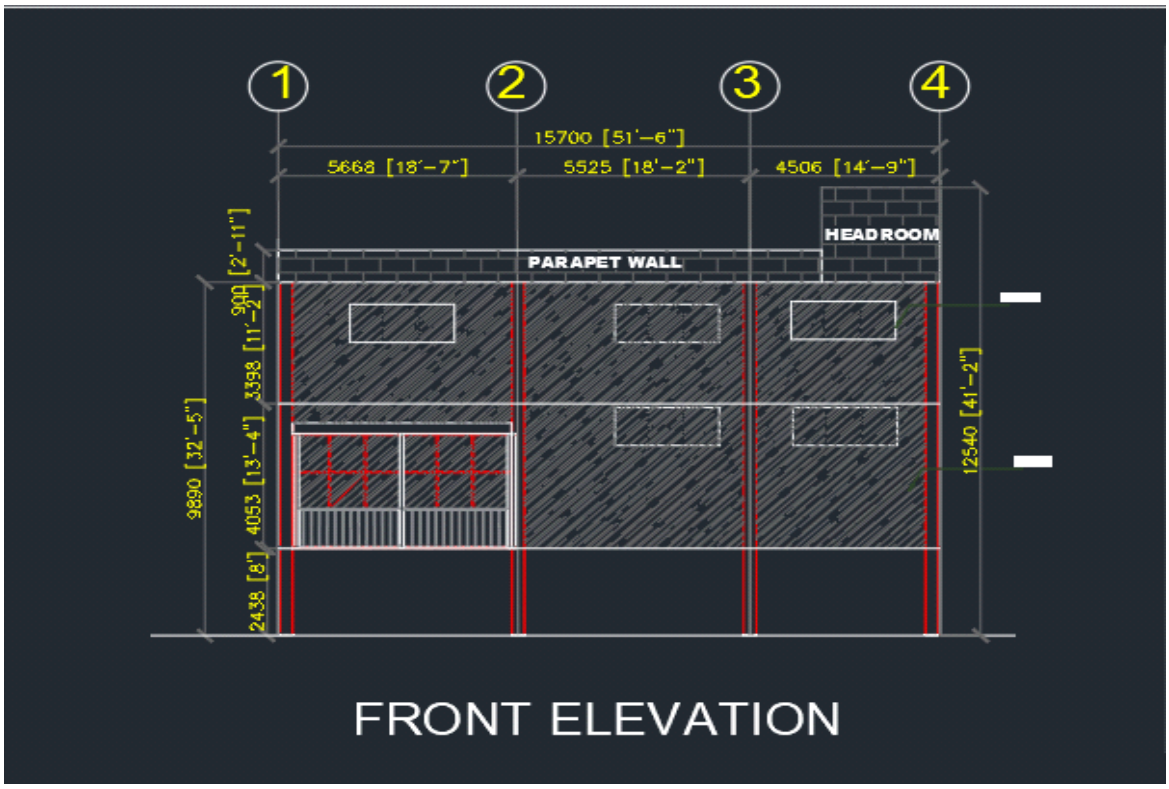

Figure 4

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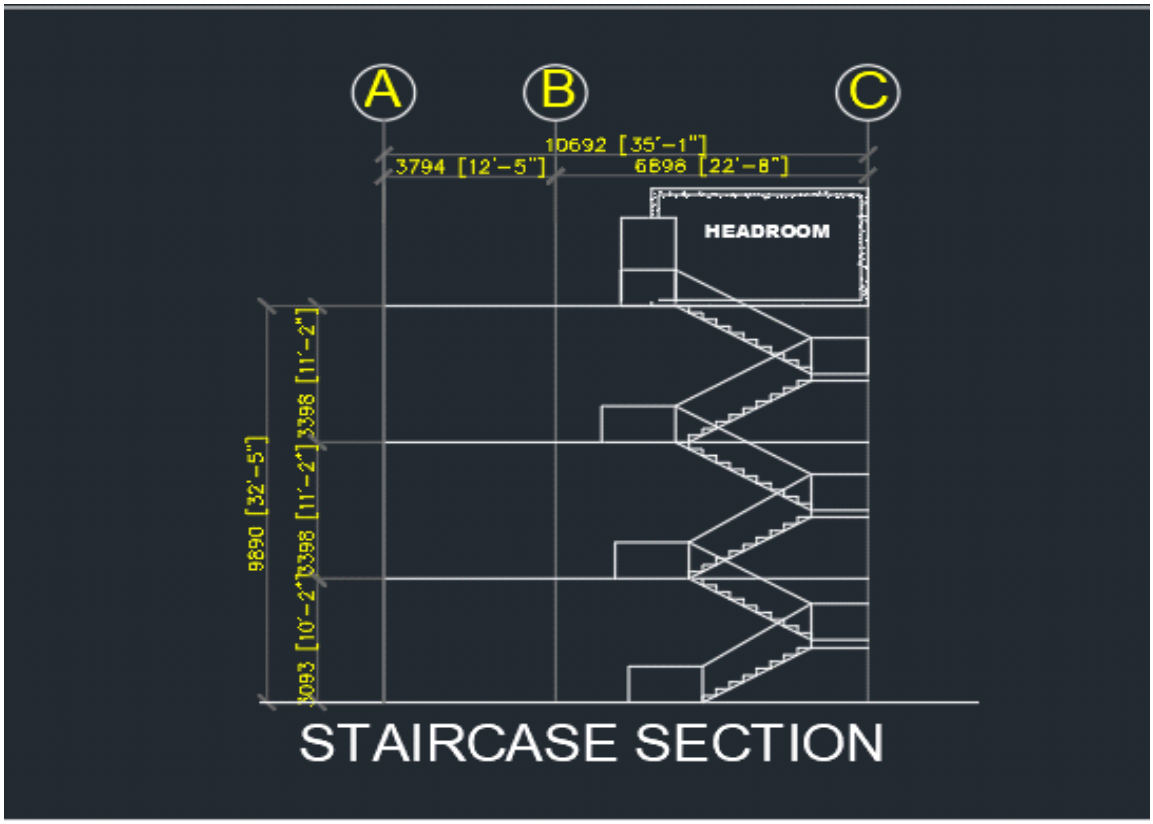

Figure 5

II. STAADPRO MODELLING

This structure was modelled using StaadPro software [1]. In this whole structure, the beam to column connection are moment connection and other connections are shear connections. There are a few exceptions, mainly where the equipment rests, which are moment connections. The model created in StaadPro software is as shown in the fig-6. Also, the bays where there is no equipment is provided with tie members in the center.

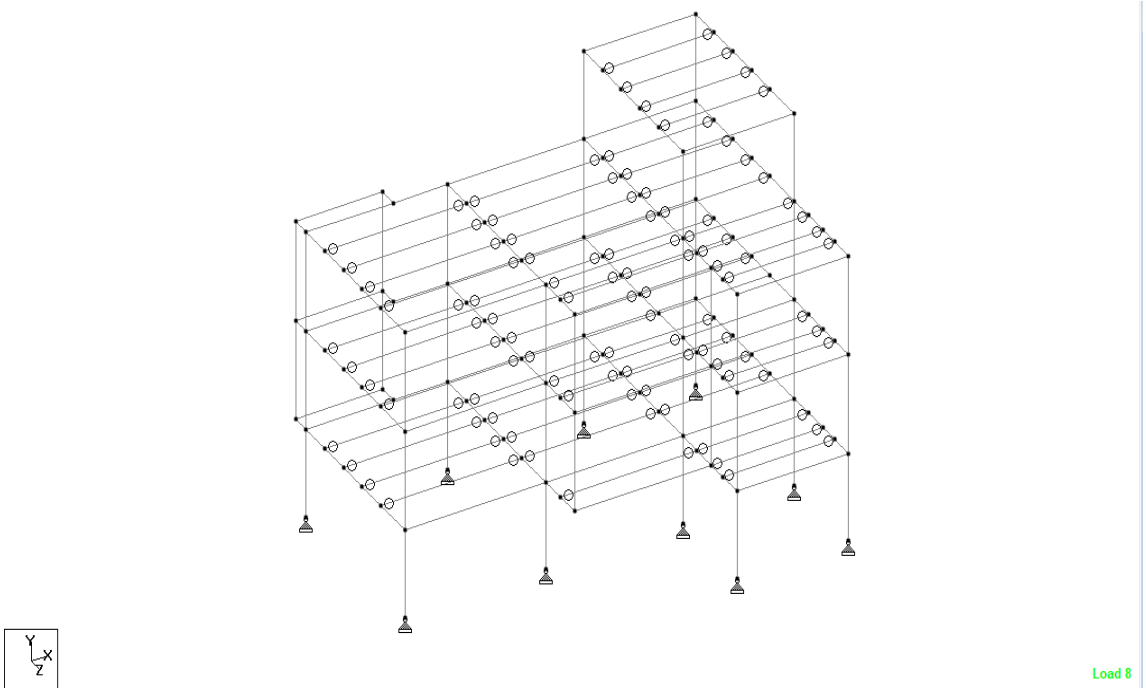

Figure 6: Analytical Model

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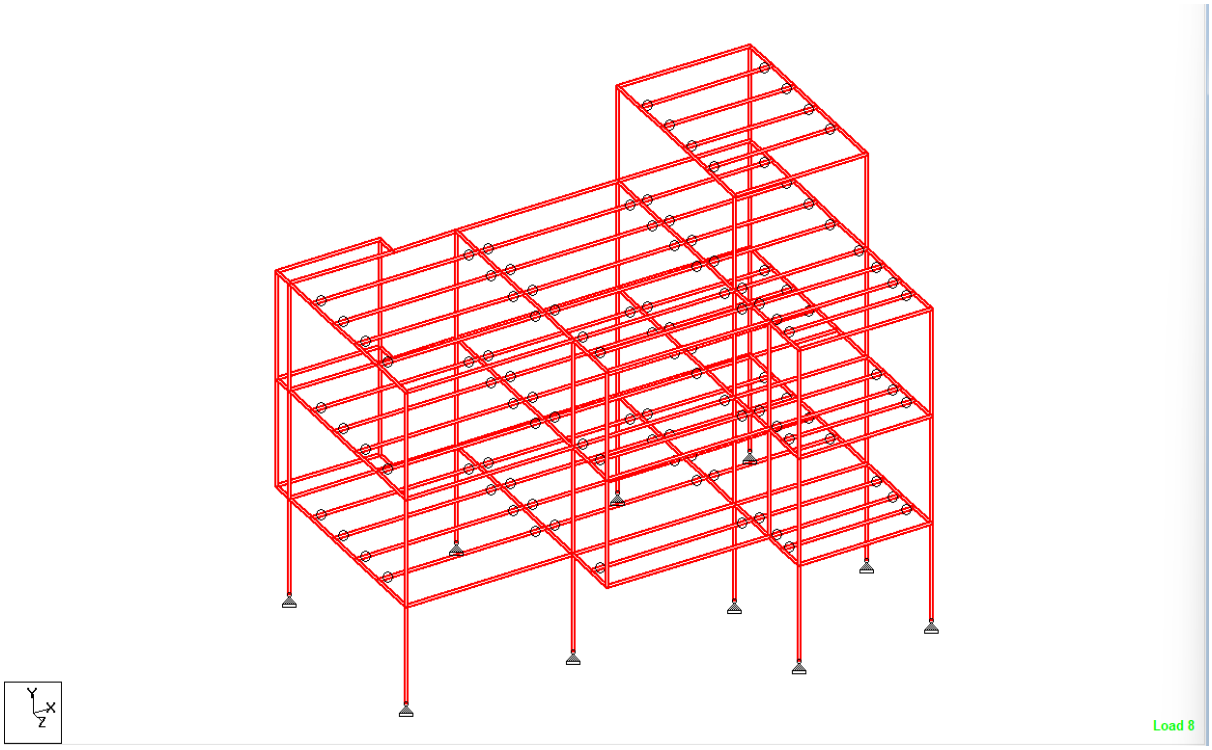

Figure 7: Parmeter Of Model

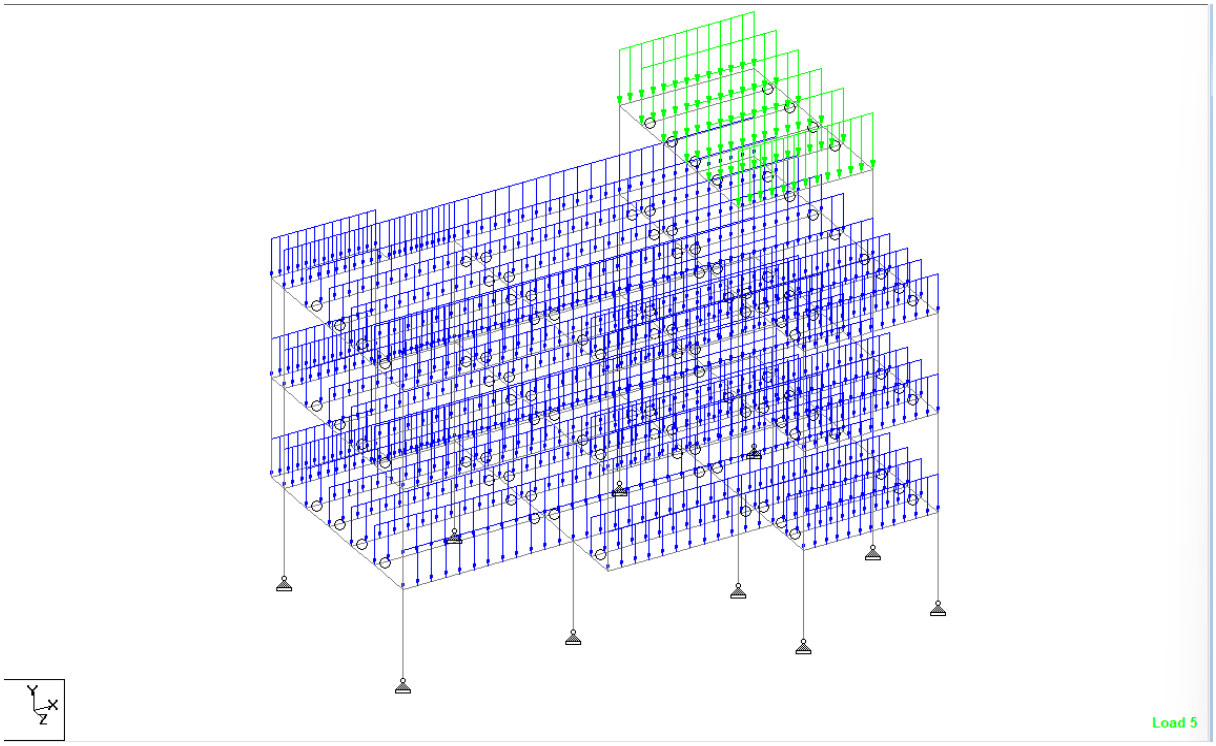

Figure 8: Dead load on Member

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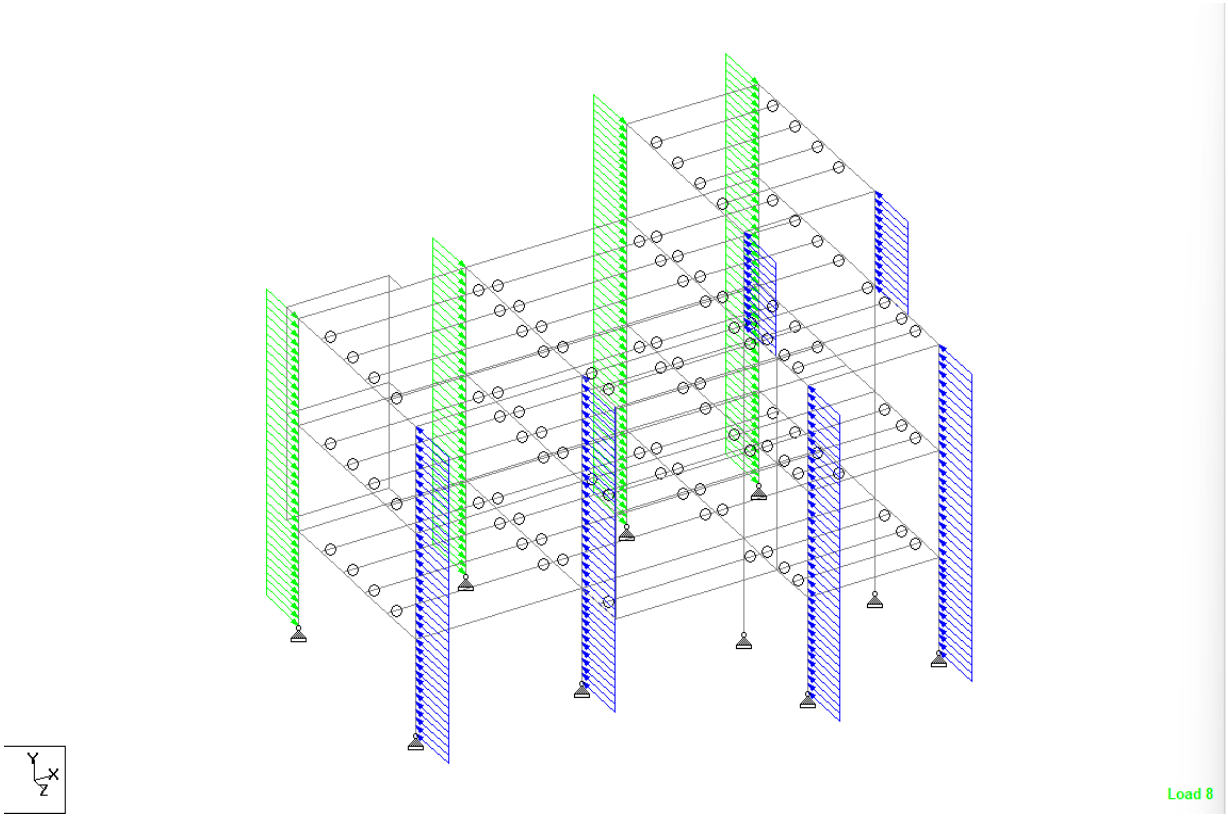

Figure 9: wind load on member

III. ANALYSIS & DESIGN

For analysis of the structure, various loads like Dead load, live load, wind load & earthquake loads (EQ) and load combinations are considered as shown in the table-1. The earthquake analysis is done by joint weight method. All the loads are considered complying to IS 875 part 1[4], part 2[5], part 3[6] & IS1893(part1): 2002[7].

Table -1: Loads & load combinations

	Dead Load	Live Load	WindLoad	EQ Load
1	1.5	1.5	-	-
2	1.2	1.2	1.2	-
3	1.2	1.2	-	1.2
4	0.9	-	1.5	-
5	0.9	-	-	1.5
6	1	1	-	-
7	1	-	1	-
8	1	-	-	1
9	1	0.8	0.8	-
10	1	0.8	-	0.8

Dead Load (DL)	**Live Load (LL)**
Self-weight of structure	On Floor = 7 KN/m2
Steel grating = 0.5 KN/m2 on each floor	On staircase: 4 KN/m2

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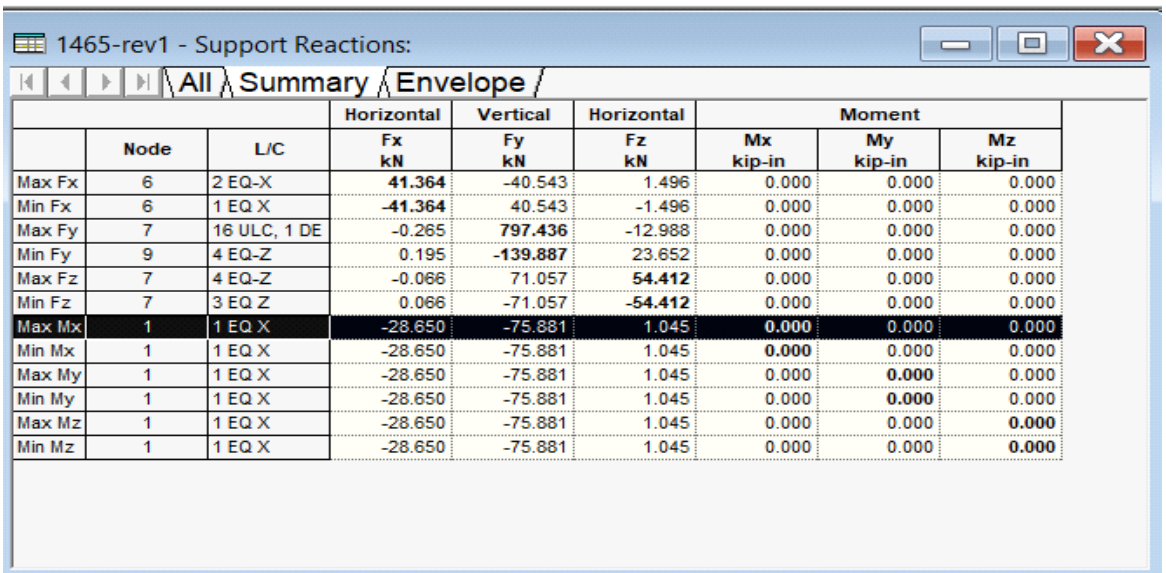
water tank dead load= 7KN/m	water tank live load= 3.9KN/M
Concrete floor =4.08KN/M	
6mm Steel plate for stairs: 0.462 KN/m2	
Wind Load (WL)	**Earthquake Load (EQ)**
Basic wind speed for Tiruvandipuram (Vb) = 39 m/s	IS 1893 – 2002/2005
Probability factor (k1) for50 years = 1	Include 1893 part 4 forindustrial structure
Terrain, height andstructure size factor (k2) = 0.985	In zone just select your city – Tiruvandipuram - Z value = 0.16
Topography factor (k3) =1	Response reduction factor – 5
Design wind speed (Vz) = 38.415 m/s	Importance Factor (F) = 1
	Soil type – Medium Soil
	Structure type – Steel FrameBuilding
	Damping Ratio – 5 %
	Foundation Depth – 3m

- **Design of Steel members**

The steel design is done in StaadPro software with reference to IS800: 2000[3]. The availability of various steel sections in the Indian market is considered for designing this structure. For the same, a small survey was carried out on various sites in and near the tiruvandipuram. In the structure, the primary beams are allotted as welded sectio, the secondary beams as , purlins as ISMC 175, 6 and afterward battens of 12mm as only connecting members i.e., they do not transfer any loads. The members allotted are demonstratedin



	Node	L/C	Horizontal Fx kN	Vertical Fy kN	Horizontal Fz kN	Moment Mx kip-in	Moment My kip-in	Moment Mz kip-in
Max Fx	6	2 EQ-X	**41.364**	-40.543	1.496	0.000	0.000	0.000
Min Fx	6	1 EQ X	**-41.364**	40.543	-1.496	0.000	0.000	0.000
Max Fy	7	16 ULC, 1 DE	-0.265	**797.436**	-12.988	0.000	0.000	0.000
Min Fy	9	4 EQ-Z	0.195	**-139.887**	23.652	0.000	0.000	0.000
Max Fz	7	4 EQ-Z	-0.066	71.057	**54.412**	0.000	0.000	0.000
Min Fz	7	3 EQ Z	0.066	-71.057	**-54.412**	0.000	0.000	0.000
Max Mx	1	1 EQ X	-28.650	-75.881	1.045	**0.000**	0.000	0.000
Min Mx	1	1 EQ X	-28.650	-75.881	1.045	**0.000**	0.000	0.000
Max My	1	1 EQ X	-28.650	-75.881	1.045	0.000	**0.000**	0.000
Min My	1	1 EQ X	-28.650	-75.881	1.045	0.000	**0.000**	0.000
Max Mz	1	1 EQ X	-28.650	-75.881	1.045	0.000	0.000	**0.000**
Min Mz	1	1 EQ X	-28.650	-75.881	1.045	0.000	0.000	**0.000**

Figure 10: Reaction table

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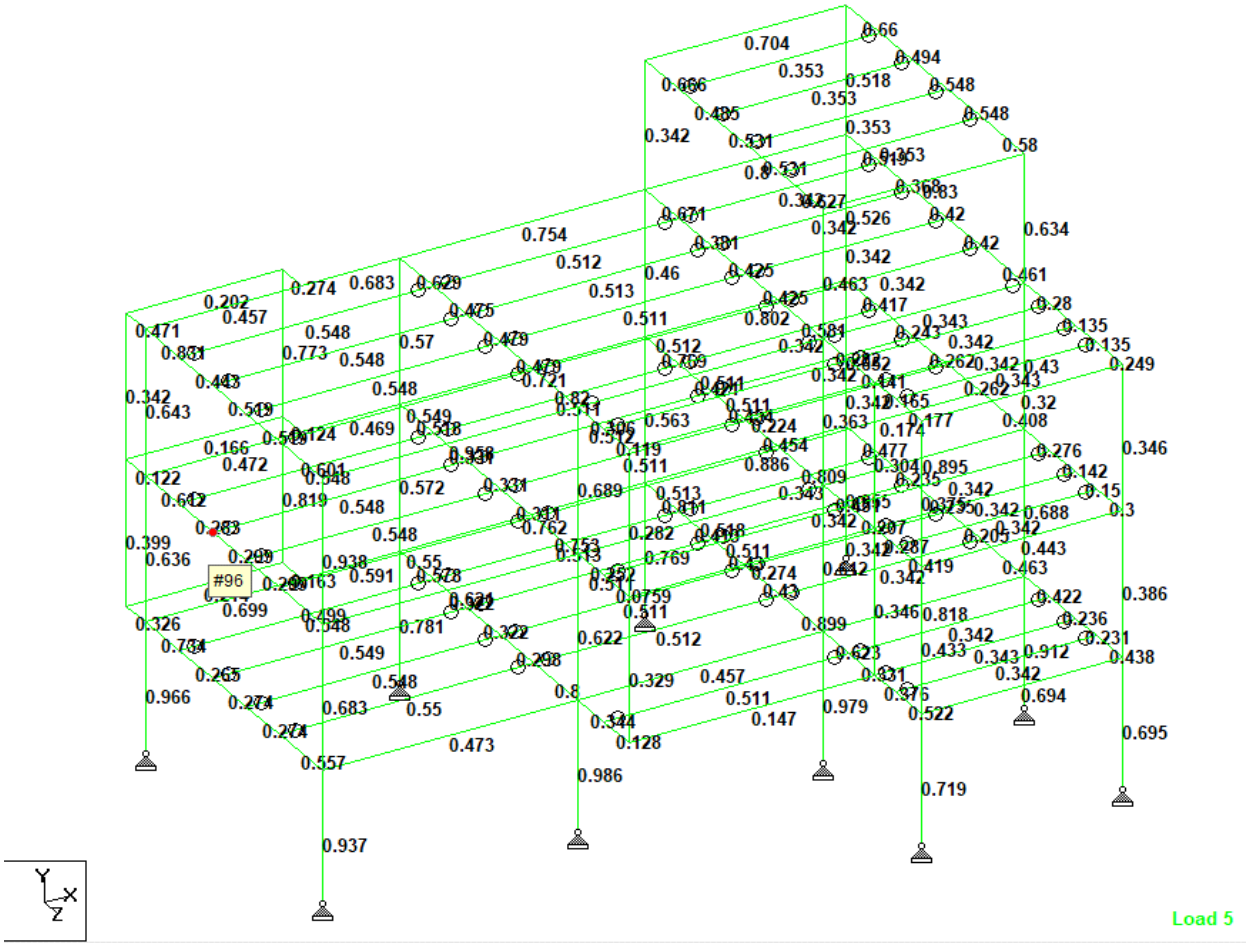

Figure 11: Ratio

IV. COST ESTIMATION

As mentioned earlier, a small market survey was carried out on various sites. In this survey, the average market rate of structural steel was also found out. Through calculations, it was estimated that total 24 tons (approx.) of steel would beconsumed and the total cost comes out to be **₹.27,79,832.**

Table -2: BOQ of structural steel

BOQ: Steel						
No:	**Material**	**Unit**	**Quantity**	**Rate ₹**	**Cost ₹**	
1.	Structural Steel	Kg	24473	65	15,90,745	
2.	Steel Fabrication	Kg	24473	30	7,34,190	
			Total		23.24,935	23.24,935
3.	Connections, base plate, bolts, cleat, etc	Kg	20% of cost		4,64,987	
	Total					**27,79,832**

V. CONCLUSION

An industrial steel building design was performed using StaadPro software. The building comprises structural steel for the superstructure and concrete for substructure. The structure comprises 2 bay frames, 7.5m each. There are a total 2 number of floors spaced at 3.2m, besides the main bay for accessing the floors. The

foundation is at 3m below the ground level. Various IS codes are referred for this design. Finally, this design was safe and can be implemented. Also, a market survey was undertaken for the market rates of various materials and activities on different constructionsites.

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