PARAMETRIC STUDY OF DIFFERENT STRUCTURAL SYSTEMS FOR LONG SPAN INDUSTRIAL STRUCTURES

Biraj Patel[1], Abbas Jamani[2]

[1]*P.G. Student, Department of Structural Engineering, L.J.I.E.T., Ahmedabad, Gujarat, India*
[2]*Associate Professor, Department of Structural Engineering, L.J.I.E.T., Ahmedabad, Gujarat, India*

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Abstract - *Now a day, our observation about the steel structures and Industrial trusses are form one of the major structural systems, which require accurate and economic design. Their span and corresponding weight plays a vital role in planning the industrial area. The shape and configuration are decided upon the span, pitch, spacing of truss, various loads and naturally the weight. In present study, 125*45 meter long span industrial structure is designed for the dynamic effects (wind and earthquake) for the different structural systems. There are also Horizontal forces, Deflection, Vertical and lateral displacement and stresses &Axial forces going to be studied. In this research work I will going to be use STAAD PRO and such design and analysis of industrial building. The purpose of this research project work is to study the cost-comparison and the stability-comparison of different structural system for long span roof industrial structures.*

***Key Words*: Long Span, Trusses, Steel, Wind Load, Roofs**

1. INTRODUCTION

What is a long span roof?

Long span roofs are generally defined as those that exceed 15 m in span. Long span roofs can create flexible, column free internal spaces and can reduce substructure costs and construction times. They are commonly found in a wide range of building types such as factories, warehouses, agricultural buildings, hangars, large shops, public halls, gymnasiums and arenas. Long span roofs can be fabricated in from a number of materials such as steel, aluminium alloy, timber, reinforced concrete and pre-stressed concrete. Steel is often preferred due to its high strength.

When a roof is to be provided for a building which does not have interior supports, but the exterior walls of which are more than 15 metres apart, some system of framing would be more economical than simple beams. Such a frame is called a truss.

2. ANALYTICAL WORK

Models are prepared in staad-pro software. A software validation was carried out to validate the accuracy of the software and the results were satisfying.

Table -1: Different Structural System to be Analysis

I SECTION RAFTER	WITH CENTER COLUMN
	WITHOUT CENTER COLUMN
PEB STRUCTURE	WITH CENTER COLUMN
	WITHOUT CENTER COLUMN
SIMLPE TRUSS	WITH CENTER COLUMN
	WITHOUT CENTER COLUMN
SPACE FRAME	WITH CENTER COLUMN
	WITHOUT CENTER COLUMN

In this study, yield strength of steel for I section 250MPa, for PEB structure 340MPa, for Truss and Space Frame structure 310MPa.

Loads applied are dead load, live load and wind load as per Indian standard code.

For dead load: Assume self weight of roofing material for G.I. sheet is 0.13 kN/m^2 on slope area. Assume self weight of purlin is 0.1 kN/m. center to center spacing of purlin is 1.4 m, center to center spacing of Truss is 6 m.

For live load: 1) Live load on purlin =750-20(α-10) N/m^2 on plan area. 2) Live load on purlin should not be less than 400 N/m^2, 3) For α<10̊ , L.L=750 N/m^2 . Span (w) = 45 m , Eaves height = 6 m , Riser height = 8.5 m

For wind load: 1) Basic wind speed at Pondicherry = 50 m/s, 2) Take risk co-efficient k1 = 1 (Life of truss = 50 years) 3) Terrain facto k2 = 0.93 (Category -2, Class –C) 4) Topography factor k3 = 1 (Annex - C)

$$Vz = Vb*K1*K2*K3$$

$$Pz = 0.6*Vz^2$$

2.1 LOAD COMBINATION FOR DESIGN:

The earthquake loads are not critical in the design of industrial building, since the weight of the roof is not considerable. Hence the following combinations of loads are considered.

1) 1.5 (DL + IL) + 1.05(CL or SL)
2) 1.2 (DL + IL) + 1.05(CL or SL) ± 0.6 WL
3) 1.2 (DL + IL ± WL) + 0.53 (CL or SL)
4) 1.5 (DL ± WL)
5) 0.9 DL ± 1.5 WL
6) 1.2 (DL + ER)
7) 0.9 DL + 1.2 ER and

Where DL = dead load, IL = imposed load, WL= wind load, SL = snow load, CL= crane load, ER= erection load.

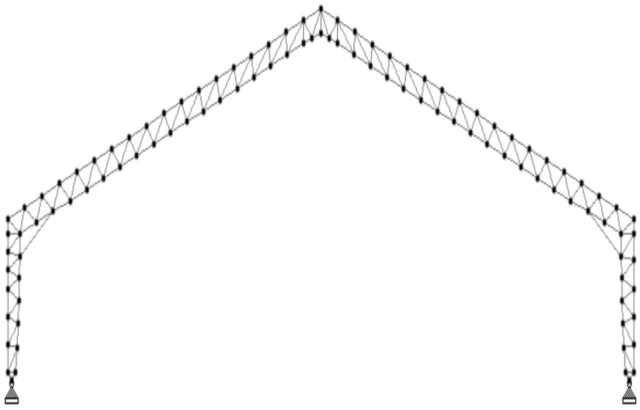

Fig -1: Elevation of Simple Truss Structure

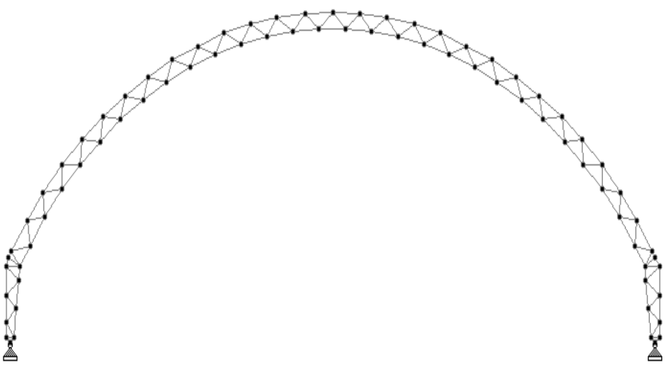

Fig -2: Elevation of Space Frame Structure

3. EXPERIMENTAL RESULTS

Comparison of different parameters in different structural systems. Different parameters like comparison of weight, comparison of deflection, comparison of lateral forces

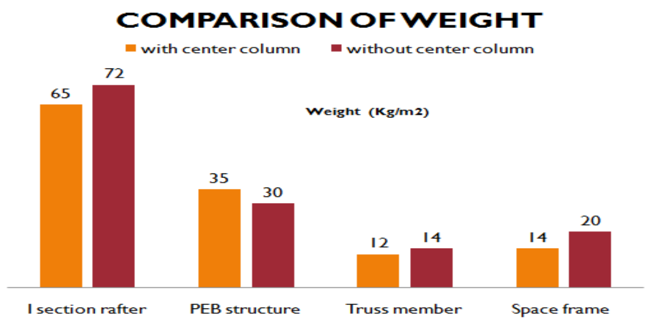

Chart -1: Comparison of weight

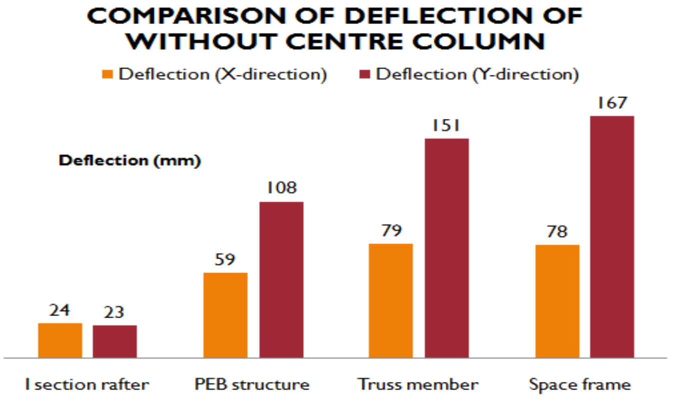

Chart -2: Comparison of deflection of without center column

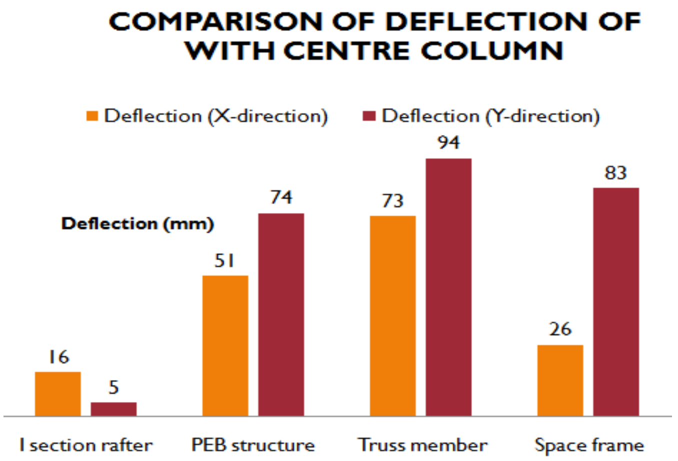

Chart -3: Comparison of deflection of with center column

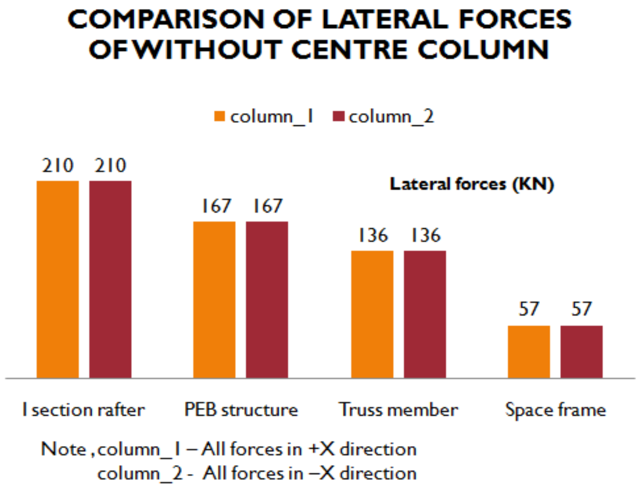

Chart -4: Comparison of lateral force of without center column

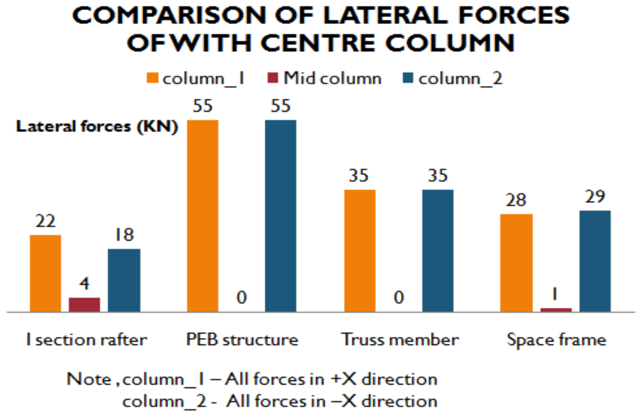

Chart -5: Comparison of lateral force of with center column

As per the site survey price of steel is 75 Rs. /kg for I section rafter, Truss member, Space frame and 95 Rs. /kg for PEB structures.

3. CONCLUSIONS

From the results the following conclusions are drawn:-

- As understood, Truss member & Space frame structure are the least weighted structures compared to other structure.
- Lateral forces are maximum in I section rafter and minimum in space frame structure without center column
- Lateral forces are maximum in PEB structure and minimum in I section rafter without center column.
- Maximum deflection was governed in space frame structure and truss member without center column
- Minimum deflection governed in I section rafter
- I section rafter structure is very expensive compared to other structure based on the weight design.
- Truss member and space frame structure are economic compared to I section rafter and PEB structures.

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CODE

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[10] I.S. 875 (Part- I) - Code of practice for Dead Load.

[11] I.S. 875 (Part- II) - Code of practice for Live Load.

[12] I.S. 875 (Part- III) - Code of practice for Wind Load.

[13] I.S. 875 (Part- V) - Code of practice for Load combination.