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Buckling Analysis of Industrial Building Using ANSYS Software for Different Loading System

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ABSTRACT: Analysis of industrial building, the structural members with maximum efficiency & minimum cost is always a challenge to the Architects & Engineers. The structural system of the building has to support the lateral loads due to wind Load in addition to gravity loads. A lateral load develops high stresses and produces way causing drift. If the buildings are not designed to resist the lateral loads, then they may be collapse resulting into the loss of life or its content. Therefore, it's important for the structure to have not only sufficient strength against gravity loads but also the adequate stiffness to resist lateral forces. But these devices are very costly and effective only for high rise buildings. Hence there is a need to study the LLRSS or technology suitable for a particular height of building. The objective of this research is to propose simple but innovative and effective LLRSS or structural technology and methodology for the wind load effect control which can be used in new as well as old building structures. The structural response parameters selected for the study are displacement and roof displacement.

KEYWORDS: equivalent static analysis, Bracing system, wind load.

I. INTRODUCTION

An industrial shed is any building structure used by the industry to store raw materials or for manufacturing products of the industry is known as an industrial building. Industrial buildings may be categorized as Normal type industrial buildings and Special type industrial buildings. Normal types of industrial building are shed type buildings with simple roof structures on open frames. These buildings are used for workshop, warehouses etc. These building require large and clear areas unobstructed by the columns. The large floor area provides sufficient flexibility and facility for later change in the production layout without major building alterations. Special types of industrial buildings are steel mill buildings used for manufacture of heavy machines, production of power etc. The function of the industrial building dictates the degree of sophistication. A structure is a collective result of idea, design, material, man power, time, finance etc. As need is the mother of invention, similarly, type of construction and its proper required design is a necessity.

II. RELATED WORK

Abhilash Joy and Aayilliajayasidhan [1] Analysis and design of an industrial building in this studied analysed multi storied Industrial building is selected and is well analysed and designed. The project was undertaken for infra Park. It is a Basement+Ground+3 storied building, located at Koratty. The analysis and designing was done according to the standard specification to the possible extend. The analysis of structure was done using the software package STAAD PRO.V8i. All the structural components were designed manually. The detailing of reinforcement was done in AutoCAD 2013. The use of the software offers saving in time. It takes value on safer side than manual work.

D.Rakesh et al. [4] Design and analysis of conventional and Pre-Engineered building (RCC and Steel) in this dissertation majorly in the industrial structures the usage of Conventional steel building and Pre-Engineered building is more conventional steel building and Pre-Engineered building concept is a new conception of single storey industrial building construction this was versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction the concept includes the technique of providing the best possible section according to the optimum requirement. The Conventional steel building and Pre-Engineered building calls for very fast construction of buildings and with good aesthetic looks and quality construction. In this study comparison of

displacement and steel quantity is done. Pre-engineered structure shows less displacements in columns and less consumption of steel. Also low cost, strength, durability, design flexibility. Based on the analytical and design results In this study the displacements was more in conventional building compared to the pre-engineered building and the axial force are more in pre-engineered building compared to the conventional steel building. The total steel take-off for PEB with primary frame spacing of 5 m is 60% of the conventional steel building.

E. Ramya et al. [5] Analysis and design of pre-engine, in this studied was included in the design of an Industrial workshop structure located at Chennai. The actual structure is proposed as a Pre-Engineered Building with length 234m and width 120m it has four spans each of 30 meters width, 30 bays each of 7.4 meters length and an eave height of 19 meters. In this study, a typical PEB frame of 30 meter span is taken into account and the design is carried out by considering dead load, live load and wind load. Generally pre-engineered buildings are faster than conventional buildings, 25% less time consuming & 30% lighter than conventional buildings.

S. D. Ambadkar and P. S. Pajgade [10] Design of steel frame industrial building compared with reinforced cement concrete industrial building, Acceptance of steel and concrete composite construction is dependent on availability of cost effective design. Use of Hollow, I- section help to promote composite construction. In India cost of a project is generally restricted to direct initial cost without any comprehensive study like Life Cycle Cost (LCC) analysis. Life Cycle Cost assessment offers whole life costing (WLC) of a structure covering current construction cost as well as all future cost. This provides better & more realistic assessment of cost involved for having any structure. As a result, there has been an increasing global awareness about the durability aspect of building & a general trend for use of LCC as a measure for proper selection of best alternative. Analysed LCC of Steel with hollow column 46.21% less as compared to RCC building, and steel with I section column 44.67% less as compared to RCC Industrial building.

Shivani Meher et al. [12] Design of industrial warehouse, in this studied gives an idea to carry out the design of an industrial warehouse. This topic of work is decided as to know the different types of force/load effects to be considered while designing industrial structure according to IS 800:2007 and the dead, live load and wind load analysis is done according to IS 875:1987 (Part-I, Part-II, Part-III). Numerical study was completed considering Mumbai Region, the necessary and appropriate loads and loading combinations were adopted. AUTOCAD plan was prepared followed by load calculations. Based on which different members like truss members, columns, purlins, etc. were selected and designed. The entire process was completed as per the standards laid down by Indian Standard. The paper effectively conveys that the industrial warehouse can be easily designed by simple design procedure in accordance with the country standards.

III. AIM

The aim of this study is analysing wind load of the industrial steel structure by using ANSYS software.

IV. METHODOLOGY

Detailed study carried related to steel structure for analytical work. Created a problem statement, select materials for analytical work and created G+4 industrial steel structure. Creating geometry we create a solid component after that slice the box where the lines are needed, the cutting edges of the block are used as the line body after the line body is created, each line can be defined as a cross section. After that apply boundary condition such as fixed support, load acting on structure and solve them.



V. THEOROTICAL FORMATION

A steel structure having location Pune is considered for study. The input details used for modelling the structure on ANSYS software are as follows

Table No 1 Detail Features of Structure

Sr. No	Parameters	Values
1	Material used	Steel grade fe-250
2	Plan dimension	20mx40m
3	Total height of structure	22m
5	Unit weight of steel	7850 kg/m ³
6	Poisson ratio	0.3-steel
9	Code of practice adopted	IS800:2007 and IS875 part I-II-III
10	Basic wind speed	39 m/sec
12	Terrain category	III
13	Class of Structure	B
14	Building locations	Pune
15	Foundation soil	Medium
16	Live load	5kn/m ²

V. ANALYTICAL RESULTS

The industrial steel structure in ANSYS for Finite element analysis. Displacement based analysis is done and obtained max load carrying capacity.

DISPLACEMENT OF STRUCTURE

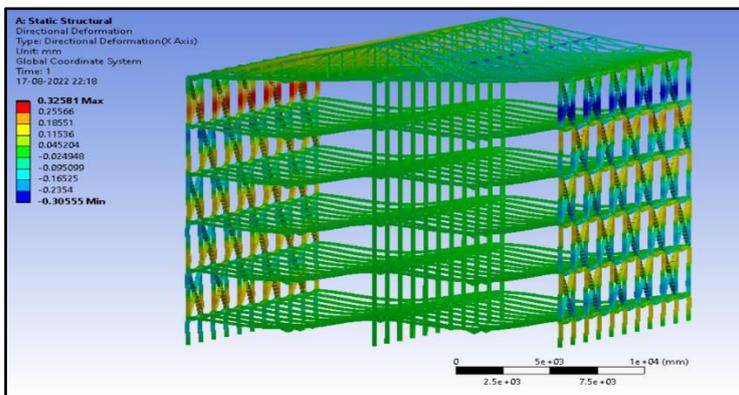


Figure 1 Displacement in X-Directions

Figure 1 shows the displacement in X direction the maximum displaced values is +0.3258mm and -0.3055mm both are similar but opposite in direction and the minimum displaced value is 0.0452mm.

Figure 2 Displacement in Z-Directions

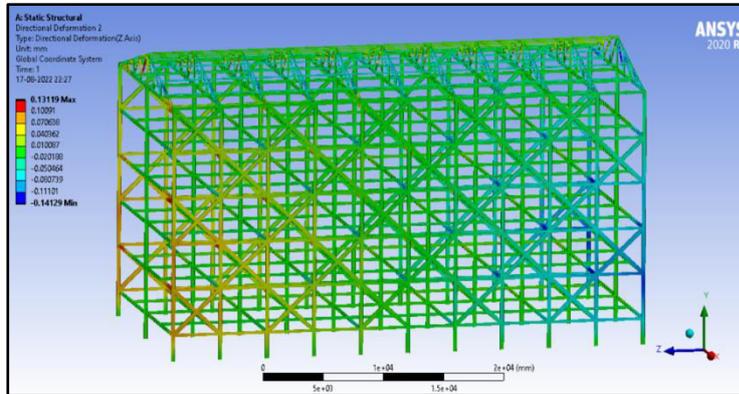


Figure 2 shows the displacement in Z direction the maximum displaced values is +0.1311mm and -0.1412mm both are similar but opposite in direction and the minimum displaced value is 0.0100mm.

SHEAR FORCE, BENDING MOMENT AND DISPLACEMENT OF CORNER BEAM

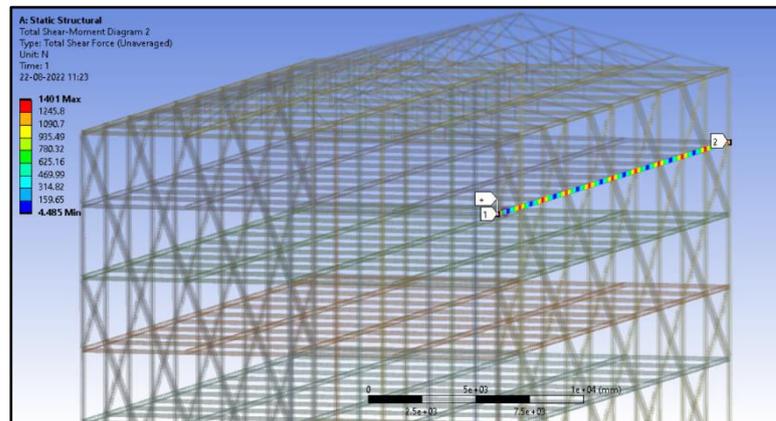


Figure 3 Shear Force, Bending Moment and Displacement of Corner Beam

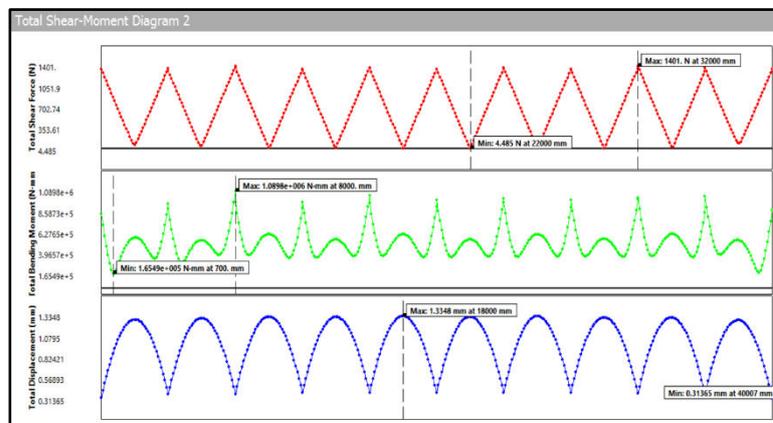


Figure 4 Shear Force, Bending Moment and Displacement Graph Of Corner Beam



Sr. No.	Length [mm]	Total Shear Force [N]	Total Bending Moment [Nmm]	Total Displacement [mm]
1	0	1352.4	8.3577e+005	0.32399
2	2000	71.041	5.7086e+005	1.2925
3	4000	1369.1	9.4657e+005	0.36494
		1321.2	8.9221e+005	
4	6000	55.302	5.4081e+005	1.3078
5	8000	1397.7	1.0898e+006	0.37223
		1370.4	9.649e+005	
6	10000	17.127	6.094e+005	1.3265
7	12000	1347.5	9.0313e+005	0.38638
		1341.5	9.6334e+005	
8	14000	19.183	5.4962e+005	1.3242
9	16000	1376.3	1.0399e+006	0.38502
		1367.4	9.5561e+005	
10	18000	10.266	6.0792e+005	1.3348
11	20000	1350.4	9.1538e+005	0.38983
		1354.9	9.9151e+005	
12	22000	4.485	5.5012e+005	1.3263
13	24000	1362.8	1.0093e+006	0.38608
		1374.3	9.651e+005	
14	26000	15.528	6.0577e+005	1.3336
15	28000	1343.5	9.1112e+005	0.38665
		1355.3	9.9104e+005	
16	30000	4.5764	5.5583e+005	1.3192
17	32000	1362.5	1.0006e+006	0.374
		1401.	1.0152e+006	
18	34000	42.239	6.078e+005	1.318
19	36000	1316.8	8.5426e+005	0.36655
		1376.8	1.0288e+006	
20	38000	89.146	5.3975e+005	1.2851
21	40000	1351.1	8.7867e+005	0.31365

Table2Shear Force, Bending Moment and Displacement Value of Corner Beam

Shear force, bending moment and displacement of corner beam is depicted in the figure 3 and same is displayed in the form of a graph as shown in figure4. As seen from the graph, maximum and minimum shear force, bending moment and displacement can be calculate.

**SHEAR FORCE, BENDING MOMENT AND DISPLACEMENT OF COLUMN
Corner Column**

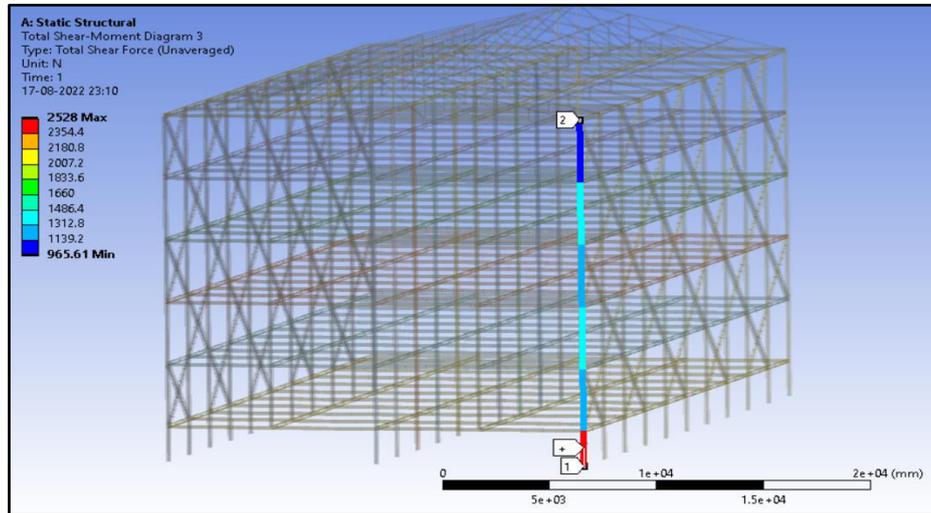


Figure 5 Shear Force, Bending Moment and Displacement of Corner Column

Sr. No.	Length [mm]	Total Shear Force [N]	Total Bending Moment [Nmm]	Total Displacement [mm]
1	250	3774.6	3.5077e+006	0
2	2000	3774.6	4.1517e+006	7.3907e-002
		1440.1	2.4963e+006	
3	3750	1440.1	1.0953e+005	7.6737e-002
4	5500	1440.1	2.545e+006	7.1932e-002
		1544.6	2.6497e+006	
5	7250	1544.6	2.6333e+005	8.1826e-002
6	9000	1544.6	2.7749e+006	7.5423e-002
		1485.1	2.6303e+006	
7	10750	1485.1	1.3464e+005	5.5878e-002
8	12500	1485.1	2.5737e+006	4.6672e-002
		1623.5	2.7442e+006	
9	14250	1623.5	2.017e+005	5.5234e-002
10	16000	1623.5	2.9411e+006	3.7947e-002
		1122.8	2.3087e+006	
11	17750	1122.8	8.5075e+005	1.7972e-002
12	19500	1122.8	1.6313e+006	2.3505e-002

Table 3 Shear Force, Bending Moment and Displacement Value of Corner Column

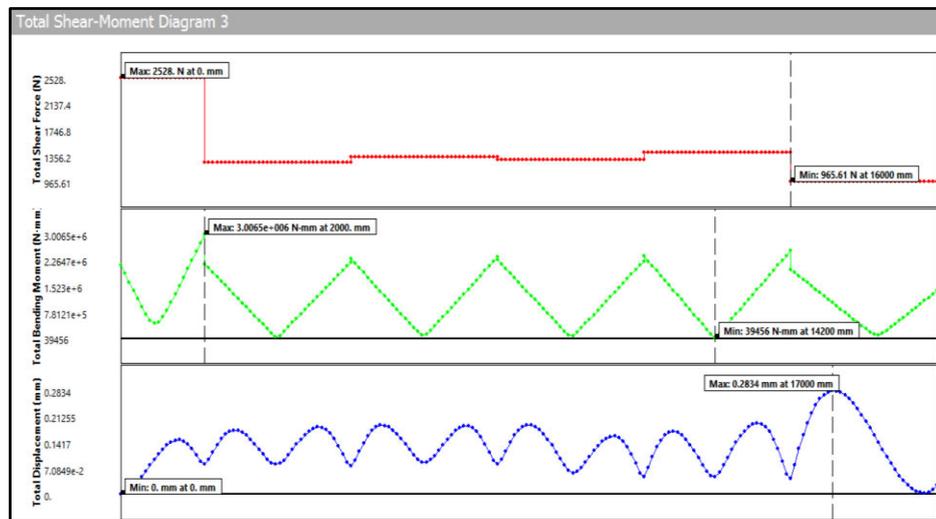


Figure 6 Shear Force, Bending Moment and Displacement Graph Of Corner Column

Shear force, bending moment and displacement of corner column is depicted in the figure 5 and same is displayed in the form of a graph as shown in graph 6. As seen from the graph, maximum and minimum shear force, bending moment and displacement can be calculate.

VI. CONCLUSION

Finite Element Analysis of Industrial steel structure with wind load of maximum displacement values in X direction is +0.3258mm and -0.3055mm both value are similar but opposite in direction which means structure displaced in positive +X direction as well as negative -X direction. And the minimum displaced value is 0.0452mm throughout the structure.

And displacement in Z direction the maximum displaced values is +0.1311mm and -0.1412mm both value are similar but opposite in direction which means structure displaced in positive +Z direction as well as negative -Z direction. And the minimum displaced value is 0.0100mm throughout the structure.

The deflection value which we found in ANSYS software of structure is acceptable for IS code.

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