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"DYNAMIC ANALYSIS OF INDUSTRIAL BUILDING USING ANSYS SOFTWARE"

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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. Hence, it is proposed to study the response of steel buildings/frames with bracings configurations as a LLRSS to control the vibration and storey drift. The structural response parameters selected for the study are displacement and roof displacement. The comparative study will be presented with respective to buckling analysis, strengthening and wet ratios using codes.

Keywords: *Seismic behavior, Response spectra, Bracing system, wind loading.*

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1. 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. Steel is a common building material used throughout the construction industry. Its primary purpose is to form a skeleton for the building or structure –essentially the part of the structure that holds everything up and together. Steel has many advantages when compared to other structural building materials such as concrete, timber, plastics and the newer composite materials. Steel is one of the friendliest environmental building materials – steel is 100% recyclable and in fact, according to the American Iron and Steel Institute, steel is the most recycled material in the United States reducing the burden on today's landfills.

Figure 1: Industrial Building

Identification of Structural Requirements

At this point, the engineer should list and examine applicable building codes, specifications, tolerances, special loadings and stiffness requirements that have been specified or should be specified for the project. A review of the owner's criteria to determine how they correspond with the required codes, specifications and stiffness requirements is necessary. For example, standard mill tolerances for beam sweep (ASTM A6) are greater than sweep tolerances allowed by many crane manufacturers for installation of crane rails. A major conflict between suppliers can be avoided if this difference is recognized early in the design stage. Office standards the design firm generally follows for specific design types should also be reviewed at this time. Special loading criteria must be examined, e.g., lateral guiding forces for cranes with lateral guide wheels and bumper forces (bumper forces are real and usually exceed longitudinal tractive forces) should be discussed with the crane manufacturer, and these criteria incorporated into the design. A discussion of stiffness requirements is in order at this point. For most projects, it is not difficult to determine strength requirements. However, stiffness requirements are generally undefined, are not given in codes, and frequently are not specified. Stiffness can determine the success or failure of a structure. This not only applies to industrial buildings, but also to residential and commercial structures. In the case of the industrial building, and particularly the crane building, the live loads, as opposed to fictitious apparent floor loads, are process loads. Consequently, the structure will be loaded to its full design load early in its life.

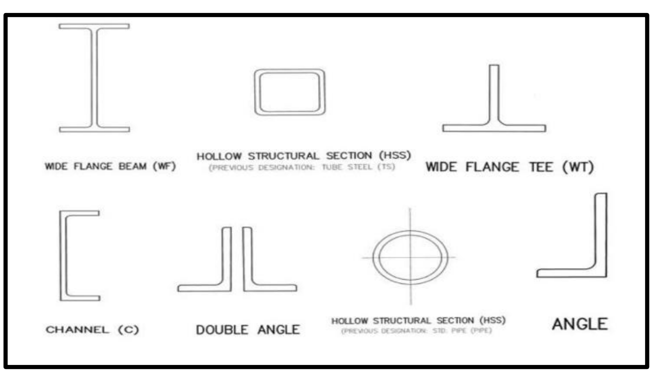

Figure 2: Different Steel section

Aim & Objective of Study

The aim of this study is Buckling analysis of the industrial building by using different type of loading to achieve the most economical and stable structure. Following are main objective of the study:

1. To perform Buckling analysis of industrial Building.
2. To analyse the industrial Building when subjected to dead load, live load and wind load by using ANSYS software.
3. To check performance of strengthening for using various load.

2. Literature Review:

S. D. Ambadkar [1] Designed of structural members with maximum efficiency & minimum cost is always a challenge to the Architects & Engineers. The most important & frequently encountered combination of construction materials is that of steel & concrete with application in multi-storey building. Acceptance of steel – 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.

Syed Firoz et al. [2] concluded pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, and the System representing one central model within multiple disciplines. Pre-engineered building creates and maintains in real time multidimensional, data rich views through a project support is currently being implemented by Staad pro software packages for design and engineering.

Mr. Abhilash Joy [3] 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 were 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.

Swapnil Dhande et al. [4] studied structural system of the building has to support the lateral loads due to earthquake and wind in addition to gravity loads. A lateral load develops high stresses and produces sway causing vibration and 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. Literature review reveals that LLRSS (Lateral load Resisting structural system) is provided in the form of devices like base isolation and dampers which controls the seismic vibration and lateral drift. But these devices are very costly and effective only for high rise buildings.

3. Methodology

Buckling Analysis

Buckling Analysis is an FEA routine that can solve all the difficult buckling problems that cannot be solved by hand calculations. Linear Buckling Analysis (LBA) is the most common Buckling Analysis. The nonlinear approach, on the other hand, offers more robust solutions than Linear Buckling.

Linear Finite Element Analysis

Eigenvalue buckling analysis is generally used to estimate the critical buckling load of structures. The analysis is a linear perturbation procedure. The analysis can be the first step in a global analysis of an unloaded structure, or it can be performed after the structure has been preloaded. It can be used to model measured initial overall and local geometric imperfections or in the investigation of the imperfection sensitivity of a structure in case of lack of measurements.

Linear Buckling Analysis

The buckling loads are calculated relative to the original state of the structure. If the eigenvalue buckling procedure is the first step in an analysis, the buckled (deformed) state of the model at the end of the eigenvalue buckling analysis step will be the updated original state of the structure. The eigenvalue buckling can include preloads such as dead load and other loads.

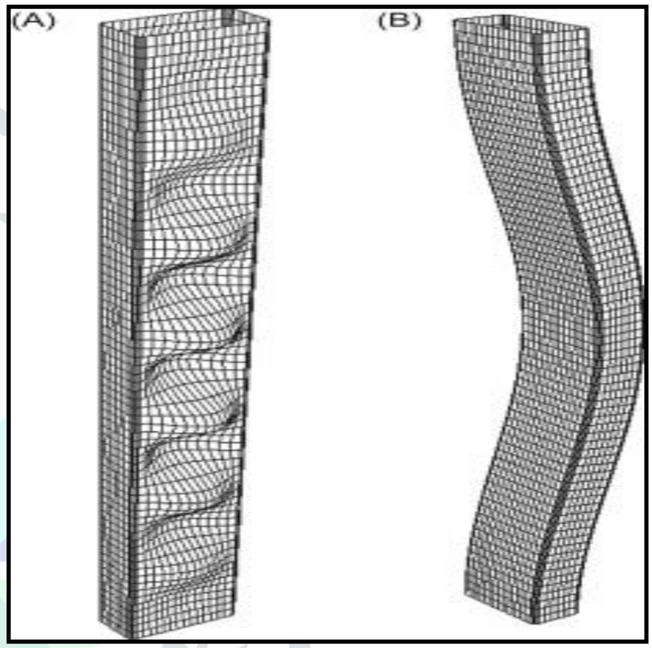

Figure 3: Buckling Analysis

Application

In sheet metal deformation and stamping, the product designer must understand the various options for material choice, and the strength-to-weight ratio is often a significant factor. In most applications, especially automotive and aerospace, the desire is to have a very strong material with as little mass (or weight) as possible. For example, materials such as aluminum, titanium, and magnesium are often chosen because of their high strength-to-weight ratio. If the mass is not a huge concern, then steel may be chosen to achieve the same strength, but at a weight penalty. However, strength and mass alone may not be the only factors to consider. When choosing a material for a sheet metal part, there are numerous other factors to consider, such as:

- Cost of raw material
- Corrosion resistance
- Weld ability (for assembly of multiple parts)
- Ease of manufacture and supply in quantity

A detailed study of analysis of steel structure using IS codes has been presented. Study has been done on steel structure. Analysis of All the above-mentioned structures have been carried out by using Indian Standard with Equivalent Static Method. Cost effectiveness of structures has also been studied only from a material point of view.

Table 1:Design data

Sr. No	Parameters	Values
1	Material Used	Steel Grade Fe-250
2	Plan Dimension	20mx40m
3	Total height of tower	22m
4	Unit weight of steel	78.50 KN/m3
5	Poisson Ratio	0.2-Concrete And 0.15-Steel
6	Code Of Practice Adopted	IS800:2007 and IS875-part -III
7	Basic Wind Speed	39 m/sec
8	Terrain category	III
9	Class of Structure	B
10	Building Locations	Pune
11	Foundation Soil	Medium
12	Live Load	5KN/M2
13	Type of section	I-Sections, L-Sections and Channel Sections

Load Combination

a. 1.5DL+1.5LL
b. 1.2DL+1.2LL+1.2WLX
c. 1.2DL+1.2LL-1.2WLX
d. 1.2DL+1.2LL+1.2WLY
e. 1.2DL+1.2LL-1.2WLY

Types of loads acting on a structure are:

1. Dead loads
2. Live loads
3. Wind loads
4. Special loads

5. Result and conclusion

Load Calculation for Industrial Building

Span = 20m
Rise = 2.5m
Number of purlins = 10 no's
Length of shed = 40 m
Roof sheet. Ac. sheet
Terrain Category – III
K3=1

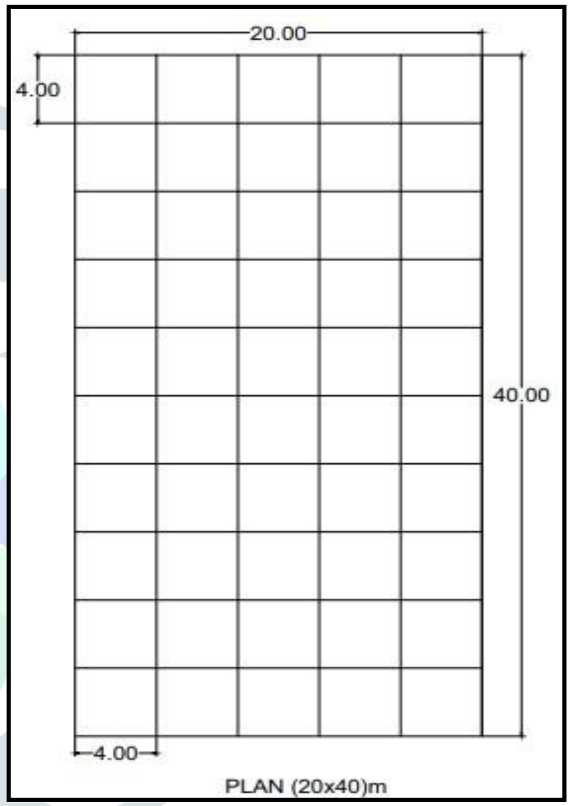

Figure 4: Elevation

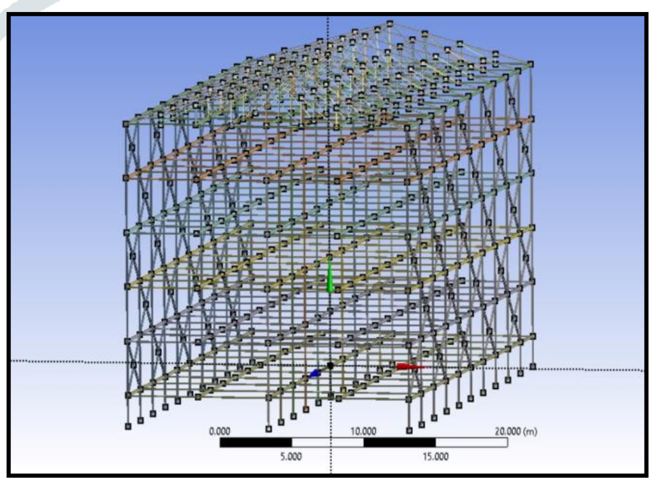

Figure 5: 3D Line model

Calculation of Dead load: -

i) 130 N\m Roofing Material sheet load
Wt. of Roofing material = 130 X 41.20
= 5356kN

ii) Wt. Of Purlin = 90X 40
= 360N

iii) Self-Wt. of Roof truss = 10(20/10) +5)
= 70N/m^2

iv) Self-wt. of half roof truss = 70 X 40
= 2800N

v) Wt. of wind Bracing

Assume 12 N/m^2 on Plan Area
Wt. Of Wind Bracing = 12X40
= 4800N

Total Dead load = 16556N/m

Each Side of truss 5 panel.

Live Load Consideration: -

- Light Duty: - 5.0 kN/m^2
- Medium Duty: - 7.0 kN/m^2
- Heavy Duty: - 10.0 kN/m^2

Wind Load calculation: -

- K1 = 1.06
- K2 = 0.98
- K3 = 1.0
    - V_b = 39 m/Sec
    - H = 22m
    - Height of structure 22m
    - Base = 2m
- Ht. of each story 3.5m
- Vz = 1.06 X 0.995 X 1 X 39
  = 41.13 m/sec
- P_z = 0.6 X Vz^2
  = 1015.169 N/m^2
  = 1.015169 kN/m^2

Deflections Criteria

The Indian Institute of Steel Construction recommends lateral drift controls between H/400 and H/200 for industrial buildings.

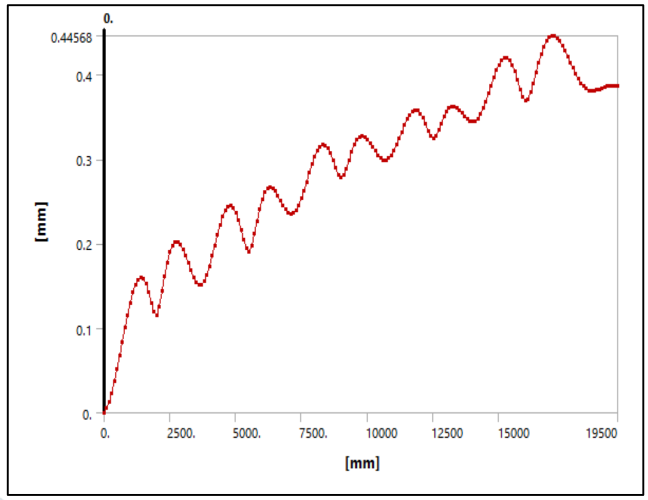

Figure 6: Total Deformation (Graph) - Corner Column

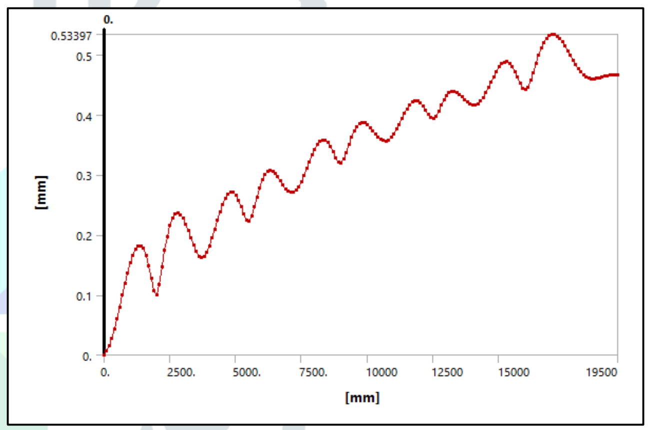

Figure 7: Total Deformation (Graph) - middle Column

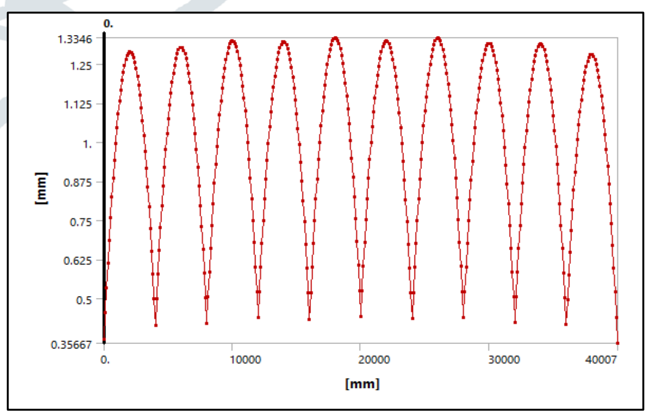

Figure 8: Total Deformation (Graph) - Corner beam

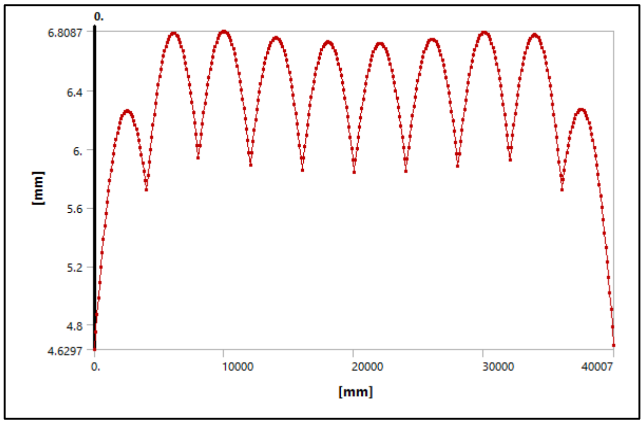

Figure 9: Total Deformation (Graph) – middle beam

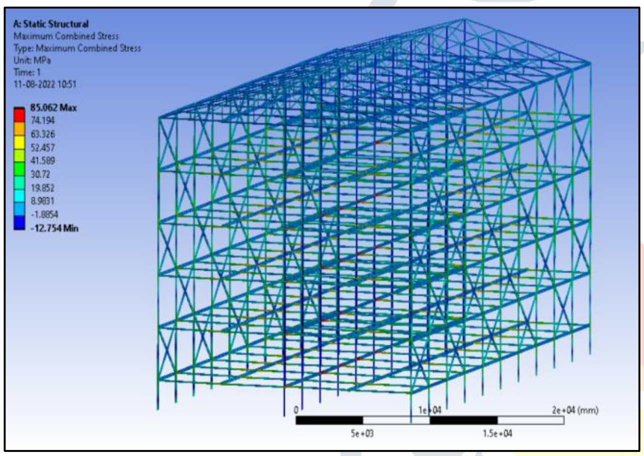

Figure 10: Maximum Combined Stresses

5. Conclusion

In this study, Relative Analysis of Industrial Truss structure with Diagonal bracing pattern with G+4 story structure.

1. The structures are analyses for Dead load, Live Load and wind Load as per IS 875 2015 part-III with medium soil and Results Compare. It has been made on different structural parameters viz. axial force, beam & column Deformations and buckling analysis etc. Grounded on the analysis results following conclusions are dra wn.
2. The industrial Truss structure with Diagonal bracing, as per Clouse Allowable displacement limit for steel structure is H/400, for industrial truss steel structure height of structure is 22m, displacement limit is 50mm. but as per design displacement is 25.599mm.

Hence the structure is safe for displacement limit.

REFERENCES

1. Swapnil N. Dhande, Y. R. Suryawanshi, Pravin S. Patil (2015) "Industrial Building Design on Seismic Issues". International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 5, May 2015.
2. Vishakha.O. Dange (2019) "Analysis of an Industrial Structure for Wind Load". Technical research organisation India.
3. K. Prabin Kumar, D. Sunny Praksh (2018) "Planning Analysis and Design of Industrial Building Using STAAD PRO". International Journal of Pure and Applied Mathematics Volume 119 No. 17 2018, 131-137 ISSN: 1314-3395 (on-line version) url: http://www.acadpubl.eu/hub/ Special Issue.
4. Mr. Abhilash Joy (2015) "Analysis and Design of an Industrial Building". International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV4IS030444 www.ijert.org (This work is licensed under a Creative Commons Attribution 4.0 International License.) Vol. 4 Issue 03, March-2015.
5. Syed Firoz, Sarath Chandra Kumar B, S. Kanakambara Rao (2012) "Design Concept of Pre-Engineered Building". International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 2, Mar-Apr 2012, pp.267-272.
6. Shivani Meher (2018) "Design of Industrial Warehouse". International Journal of Engineering Research & Technology (IJERT) http://www.ijert.org ISSN: 2278-0181 IJERTV7IS020170 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Published by: www.ijert.org Vol. 7 Issue 02, February-2018.
7. S. D. Ambadkar (2012) "Design of Steel Frame Industrial Building Compared with Reinforced Cement Concrete Industrial Building". International Journal of Scientific & Engineering

Research, Volume 3, Issue 6, June-2012 1 ISSN 2229-5518.

8. D.Rakesh, V.Sanjay Gokul, G.Amar (2016) "Design and Analysis of Conventional and Pre Engineered Building (R.C.C and Steel)". 2016 IJEDR | Volume 4, Issue 2 | ISSN: 2321-9939.