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DESIGN AND ANALYSIS OF AN INDUSTRIAL WAREHOUSE USING STAAD PRO

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Abstract:

In India, due to rapid growth of industrialization, there a rise a need of storage and manufacturing of goods which can be fulfilled by proper designed industrial warehouse. This study 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 warehouse with the help of literature review. This structure is proposed to design according to IS 800:2007 and the dead, live, the wind load analysis is done according to IS 875:1987 (Part-I, Part-II, Part-III). The area for proposed warehouse design and analysis were decided and proper architectural plan was prepared according to the conditions within the seismically zone-II(Visakhapatnam). The forces acting on the adjacent members when one of the members is under loading and calculating the excess stresses and ratios induced in these connected members and also, the moments and forces produced are obtained and mentioned. Then different members of warehouse for e.g., Truss members, columns and connections, etc. were designed and final result are obtained. Finally, the conclusion is made that warehouse can be designed and analysed easily adopting STAAD Pro.Vi8 and IS specifications.

Keywords: — Warehouse, Load Combination, Dead Load, Live Load, Wind Load, Nodes, AutoCAD.

❖ 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.

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A large building where raw materials or manufactured goods may be stored prior to their distribution for sale. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc. They are usually large plain buildings in industrial parks on the outskirts of cities, towns or villages. They usually have loading docks to load and unload goods from trucks. Warehouses vary in size from small home garages to massive warehouses like Amazon com's fulfilment centres that can span 14 acres and even bigger.

❖ Loads and load combinations:

• Dead load

According to IS: 875 (Part I)-1987, Dead load comprises of self-weight of the structure, weights of roofing, G.I. sheets, gantry girder, crane girder, purlins, sag rods, bracings and other accessories.

• Live load.

According to IS: 875 (Part II)-1987, for roof with no access provided, the live load can be taken as 2 kn/m².

• Wind load

Wind load is calculated as per IS: 875 (Part III)- 1987. The basic wind speed for the location of the building is found to be 50 km/h.

• Load combinations:

According to IS: 875 (Part V)-1987, Following codes are used for deciding load combinations and for designing members according to it.IS CODE
1. IS 875-1987 for Load calculation
2. IS 800:2007 for Steel Design

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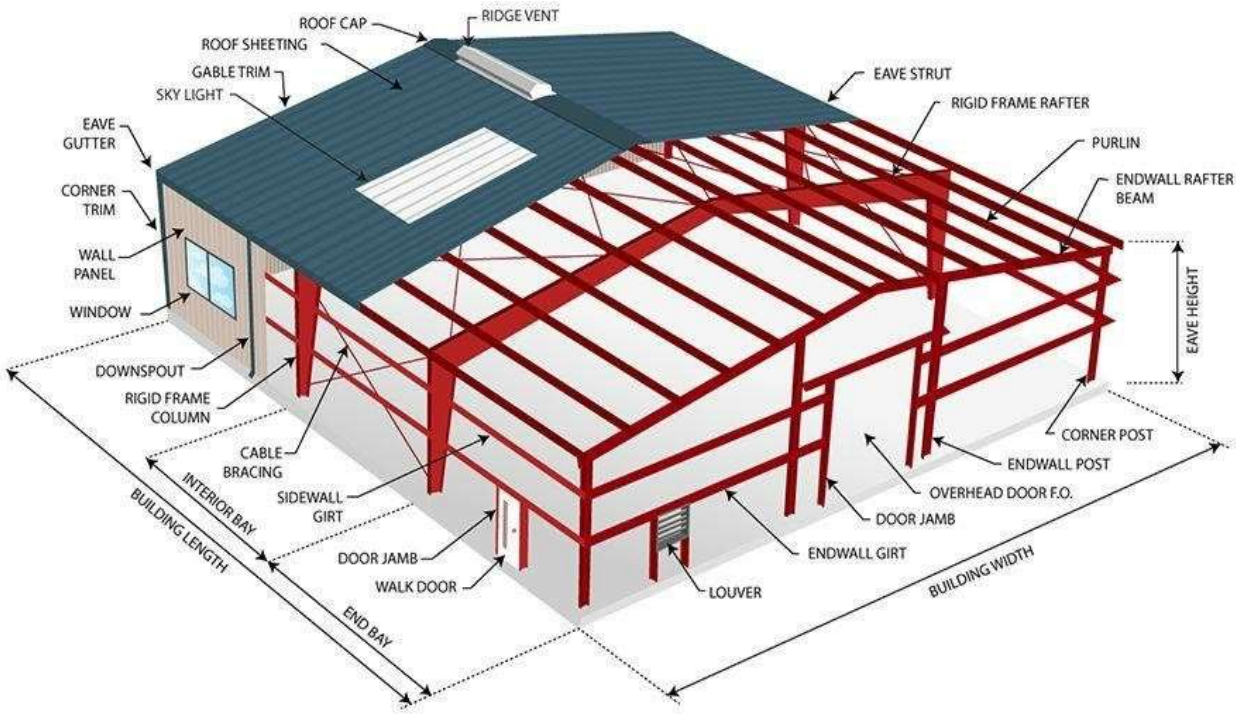
Components of Warehousing :



As shown in fig (1)

❖ SCOPE:

Purchase of raw material is an integral part of any business. These raw materials need to be kept in a safe place, hence in order to rectify this need warehouse are constructed. In future due to rapid growth in industrialization there will occur a great need to construct economically efficient warehouses. The design will serve the purpose of storage of goods, manufacture, motor garage, etc.

❖ OBJECTIVE:

To identify various loads and load combinations acting on the structure. To design the industrial warehouse as per its drawing details.

• To check the structure as per IS-800 code calculations, with all the members as per the Design.

❖ LITERATURE STUDY:

This section discusses the literature reviewed related to design of industrial warehouse.

M. Sunitha completed a numerical study and concluded that Weight of single Truss utilizing Angle and Pipe both is less compared to PEB yet because of Weight of Channel Purlin, Weight of Steel Truss Building is on higher side.
Vaibhav B. Chavan, determined optimum span length for economy.

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C.M. Meera made a comparative study between Pre-Engineered Building (PEB) and Conventional Steel Building (CSB) and analysing the design frames using structural analysis and design software STAAD PRO.

Subhrakant Mohakul designed an Industrial warehouse and did a thorough study of behaviour of members due to effect of failure at connecting joints.

Manan D.Maisuri stated that the consumption of steel of whole industrial building can be reduced by deciding appropriate geometry of truss and by using hollow steel section with compare to conventional steel section. Thus, stating tube sections are most economical.
A.Jayaraman presents a study on behaviour and economical of roof trusses and channel section purlins by comparison of LSM and WSM.

❖ METHODLOGY:

STAAD.Pro: Software used for analysis:

features a state-of-the-art user interface visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD.Pro is the professional's choice for steel, concrete, timber, aluminium and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

STAAD.Pro consists of the following: The STAAD.Pro Graphical User Interface: It is used to generate the model, which can then be analysed using the STAAD engine. After analysis and design is completed, the GUI can also be used to view the results graphically. The STAAD analysis and design engine: It is a general-purpose calculation engine for structural analysis. as shown in STAAD icon.

DESIGN OF WAREHOUSE USING STAAD.Pro:

Step - 1: Creation of nodal points. Based on the column positioning of plan we entered the node points into the STAAD file

Step - 2: Representation of beams and columns. By using add beam command we had drawn the beams and columns between the corresponding node points.

Step - 3: 3D view of structure. Here we have used the Transitional repeat command in Y direction to get the 3D view of structure.

Step - 4: Supports and property assigning. After the creation of structure, the supports at the base of structure are specified as fixed. Also, the materials were specified and cross section of beams and columns members was assigned.

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Step - 5: 3D rendering view. After assigning the property the 3d rendering view of the structure can be shown

Step – 6: Assigning of wind loads. Wind loads are defined as per IS 875 PART 3 based on intensity calculated and exposure factor. Then loads are added in load case details in +X, -X, +Z, -Z directions.

Step – 7: Assigning of dead loads. Dead loads are calculated as per IS 875 PART for including self-weight of structure.

Step - 8: Assigning of live loads. Live loads are assigned for truss structure as 2 kN/m based on IS 875 PART 2.

Step - 9: Adding of load combinations. After assigning all the loads, the load combinations are given with suitable factor of safety as per IS 875 PART 5.

Step - 10: Analysis after the completion of all the above steps we have performed the analysis and checked for errors.

Step - 11: Design. Finally concrete design is performed as per IS 800 by defining suitable design commands for different structural components. After the assigning of commands again we performed analysis for any errors.

RESULTS AND DISCUSSION:

Step-1: Creation of Nodal points. Based on the column positioning of plan we entered the node points into the STAAD file.

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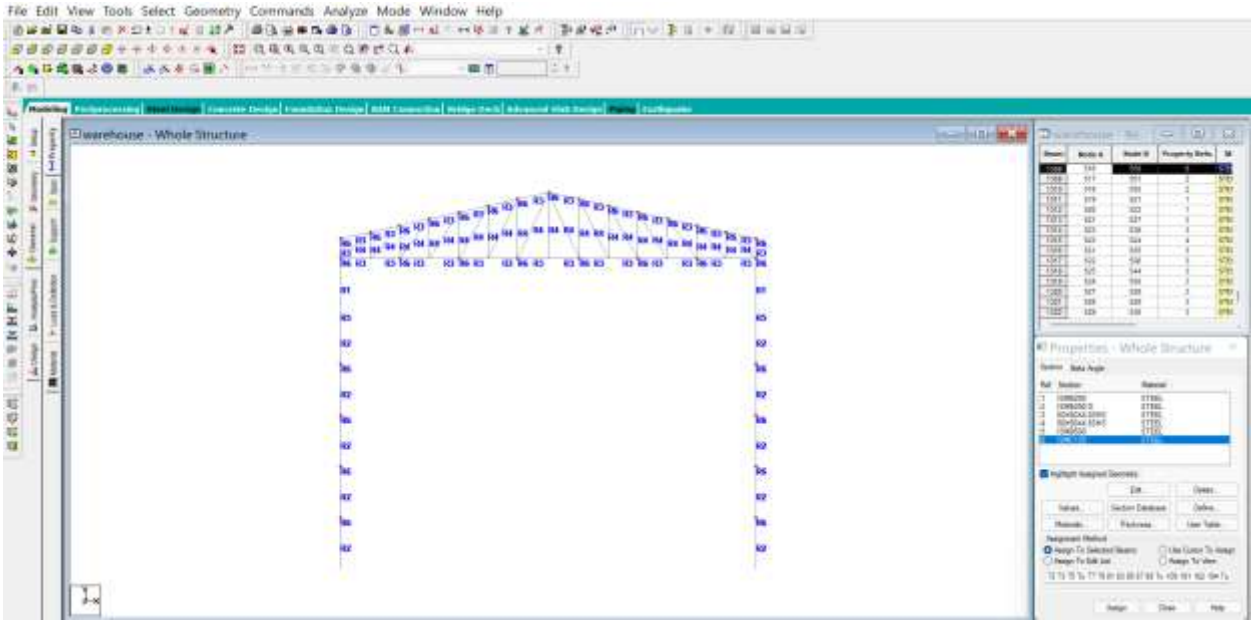
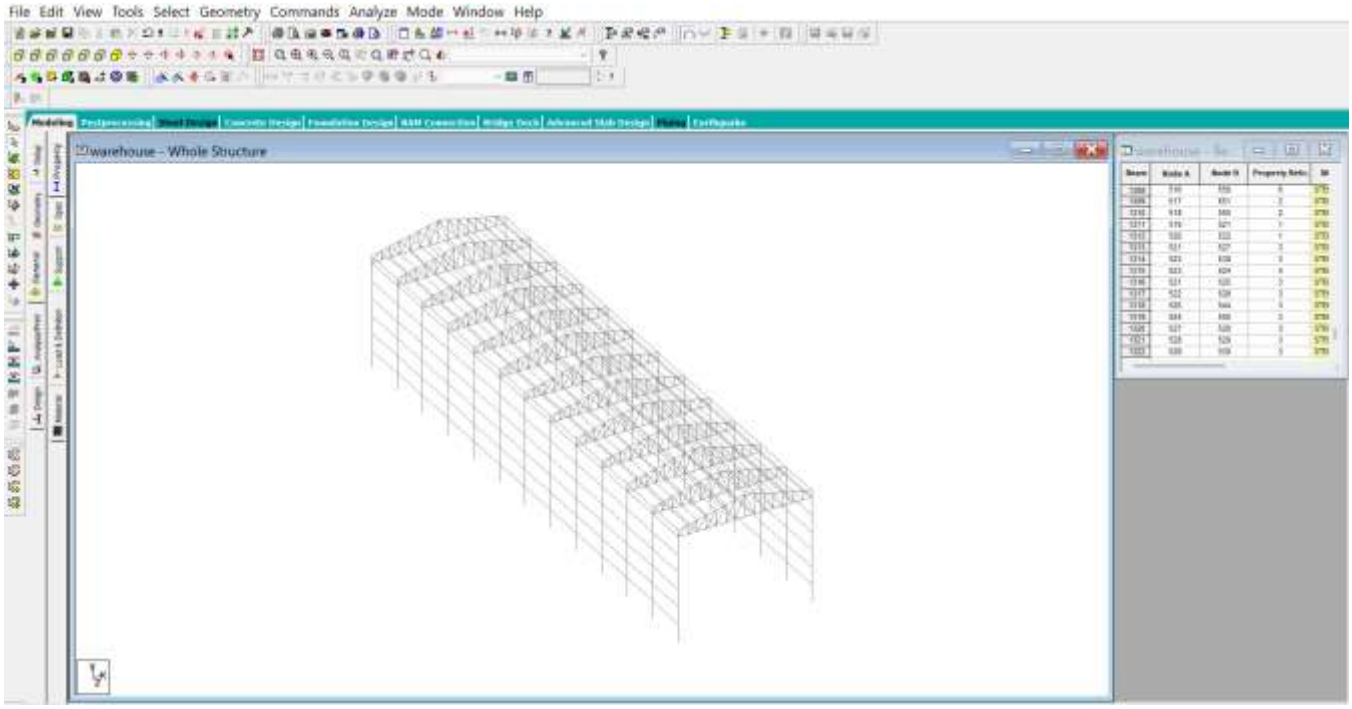


As shown in fig (2)

Step-2 **:** Representation of beams and columns . By using add beam command we had drawn the beams and columns between corresponding nodal points.



As shown in fig (3)

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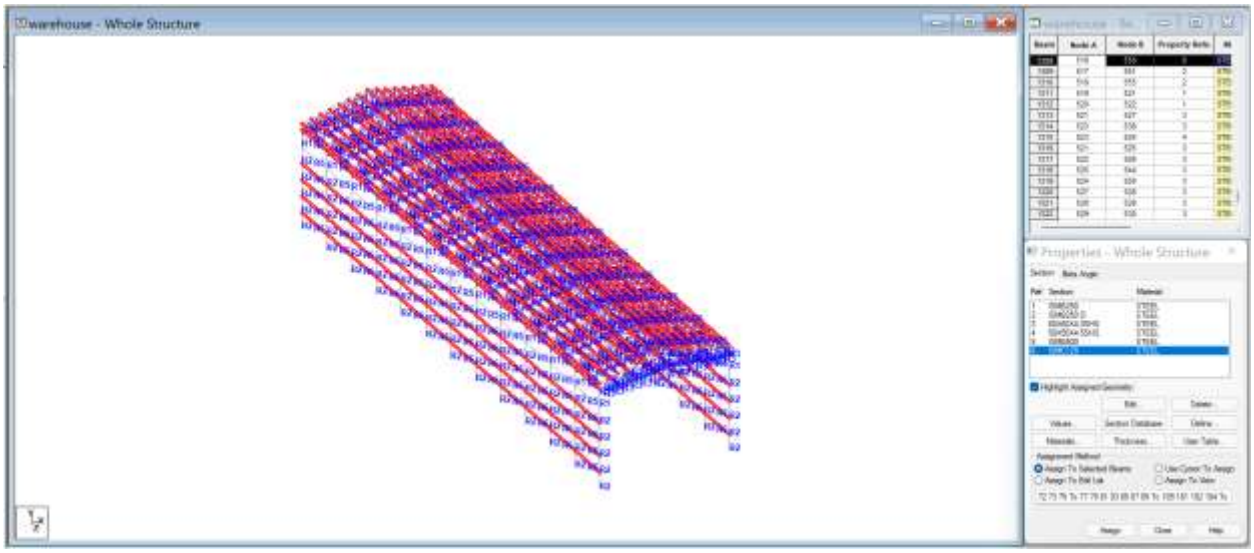
Step-3: 3D view of structure, Here we use the traditional repeat command in Y- direction to get the 3D view of structure.

Step-4: Supports property assigning. After the creation of structure the supports at the base of the structure are specified as FIXED. Also the materials were specified and **cross-section of beams & column**



As shown in figh (4)

Step-5: 3D Rendering view. After assigning the property the 3D rendering view of the structure can be shown

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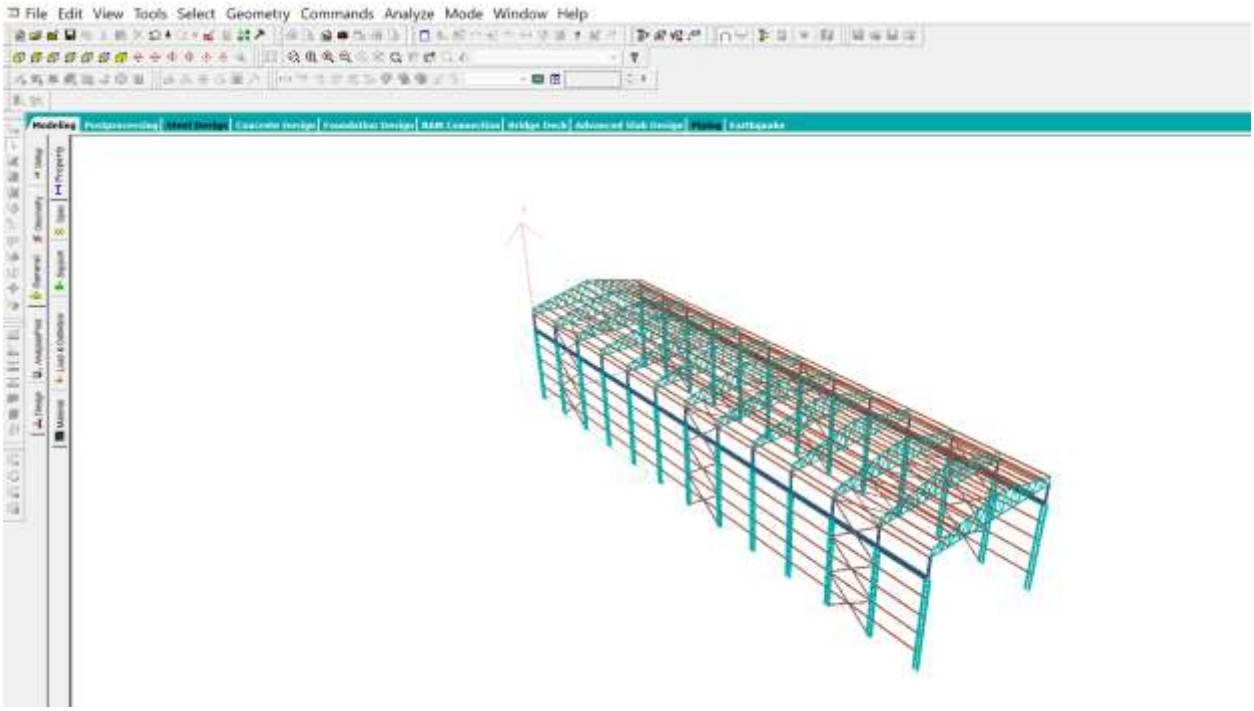

As shown in fig (5)

Step-6: Assigning of wind loads. Wind loads are defined as per IS 875 PART 3 based on intensity calculated and exposure factor. Then loads are added in load case details in +X,-X,+Z,-Z directions.

Step-7: Assigning of Dead loads. Dead loads are calculated as per IS 875 PART 1 for including self-weight of structure.

Step-8: Assigning of Live loads. Live loads are assigned for truss structure as 2kN/m^2 based on IS 875 PART 2.

Step-9: Adding of load combinatins. After assigning all the loads, the load combinations are given with suitable factor of safety as per IS 875 PART 5. **Step-10:** Analysis after the completion of all the above steps we have performed the analysis and checked for errors.

Step-11: Finally steel design is done as per IS 800 by defining suitable design commands for different structural components. After assigning of commands again we perform analysis for any errors.

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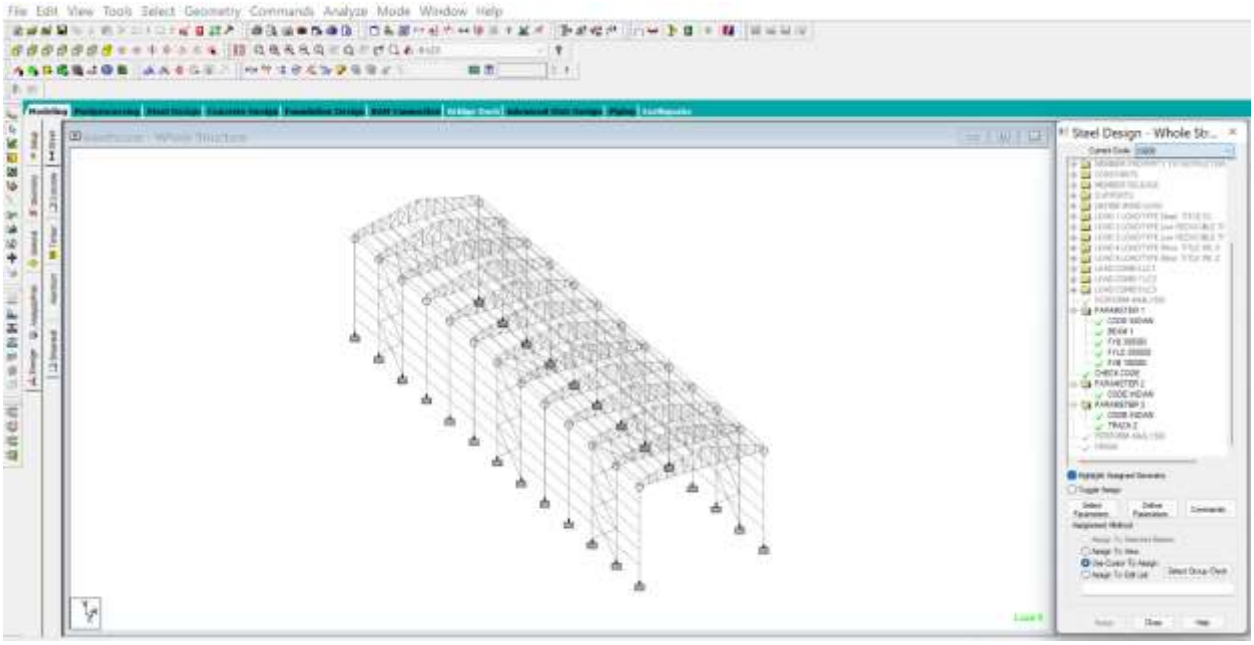
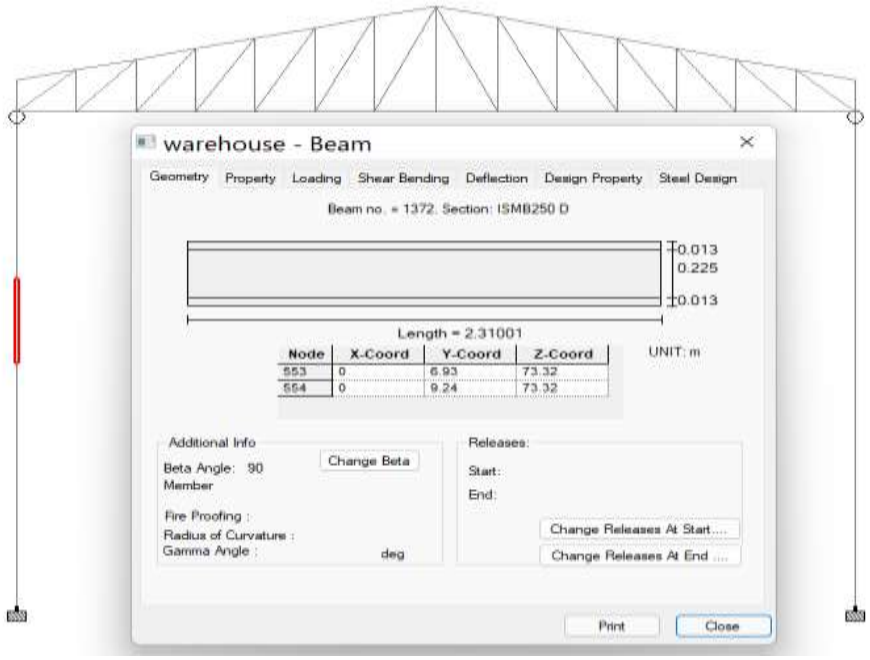


As shown in fig (6)

RESULTS:

Properties & Steel design of different members are given below:

a) Column Member :



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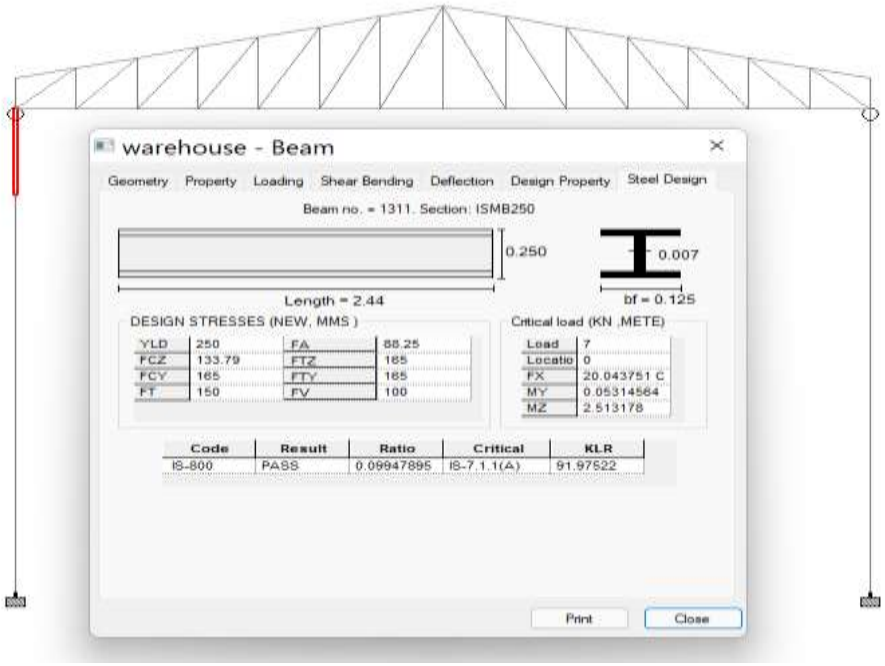
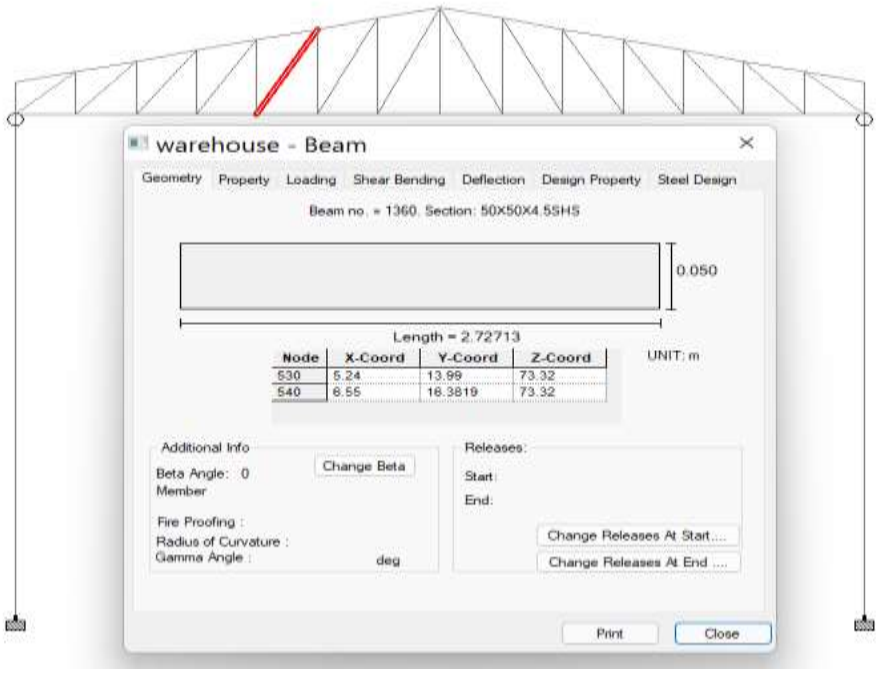
As shown in fig (7)

b) Gantry girder :



As shown in fig (8)

c) Truss member :



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as shown in fig (9)

CONCLUSION:

From the work carried out in STAAD. Pro, we can conclude that:

1. Using STAAD. Pro the analysis of warehouse buildings has completed much quicker when compared with manual analysis.
2. It is observed that the reinforcement percentage in the sections is more in the case of software design when compared to manual calculations.
3. Designing using software like STAAD. Pro reduces a lot of time in design work.
4. The reinforcement details of every member can be obtained using STAAD. Pro.
5. All the list of failed frame sections can be obtained in the report given by STAAD. Pro so that we can change the property data for a better section.
6. Accuracy is improved by using the software.
7. The reinforcement details of each member can obtain directly after analyzing the building.
8. Deflection in primary members of the mono column structure is under the given limit regarding IS 456:2000.

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