OPTIMIZATION OF TRUSSES OF WAREHOUSE

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ABSTRACT - *Optimization of Truss is mainly carried out to find optimum quantity of steel to be used. In this project, the authors determines the usage of optimum steel for FAN and FINK trusses by using Software's like STAAD-Pro and SAP-2000. Parameters like various configurations, various angles of slope roof at 25˚, 27.5˚& 30˚ and rise of trusses are taken into account for analyzing and designing to determine the optimum steel take off. Live load, Wind load, Earthquake loads are calculated on the basis of Indian Standard code provisions and these values are being directly given as an input in STAAD-Pro and SAP-2000 software's. Initial sections of the member for trusses are assigned as per prime analysis and designed, and then the sections are revised to get optimum weight based on the load carrying capacity ratio. Commonly, the cost of construction will certainly increases by the increase in usage of steel, this optimization of truss will be helpful in finding out the optimum quantity of steel to be used in construction which will have a benefit able impact on construction cost of Warehouse Building.*

Keywords: Fan type, Fink type, various slope of roof, Rise of truss, STAAD-Pro and SAP-2000.

1. Objective

The main aim of this thesis is to find out a optimized steel quantity for various trusses with various slopes of roof and comparing the following by using the two software's mentioned above.

1. To compare the Fan type truss and Fink type truss having a building area of about 20m*40m with various slope of roof, to find which truss and slope of roof truss gives a optimized steel quantity.

2. To compare the results of two software's and to find which software gives optimum steel quantity.

2. Review of Literature

Nikhil B. Fultariya published in a topic of "**Weight Optimization of Steel Roof Truss with Different Types, Spans & Slopes of Roof"**. The design loads are from IS 875 Part-1 to 3 and design of member as per IS: 800:2007. The entire work of analysis is carried in Staad.pro software. Author conclude, change in type of truss with span and roof inclination give us lighter weight truss. e.g. for 30.0 mt span, Fan type with 12^0 is lighter weight truss.

Er. SanjeevKumar, BrahmjeetSingh, Er. BhupinderSingh published in a topic of **"Optimization of Roof Truss Using STAAD-Pro"** effect of different spacing, span, and pitches, in order to find out the most economical truss by using angle section. In design of steel trusses different types of geometries (Howe truss, Pratt truss, Fink truss, King post truss and Queen post truss are etc.,) and sections (Angle section, Tube section, square hollow section etc.,) are widely used. In present work Howe roof truss of span varying from 10m to 40m has been analyzed for different geometries to get the desired optimum truss design. Finally, the truss with a least value of steel takeoff is considered as most economical truss.

Er. Gurinder Kaur, Er. Rajwinder Singh Bansal, Er. Sanjeev Kumar published in a topic of **"Shape Optimization of Roof Truss".** For same span the among all the nine truss, Warren truss geometry seems to be the most optimum truss configuration with about 10% savings in weight when compared to its closest contenders Pratt truss or Howe truss.

3. Analysis and Design of Warehouse

3.1 Modeling of fan truss using STAAD-Pro:

3.1.1 Modeling of the truss for 25˚ slope roof

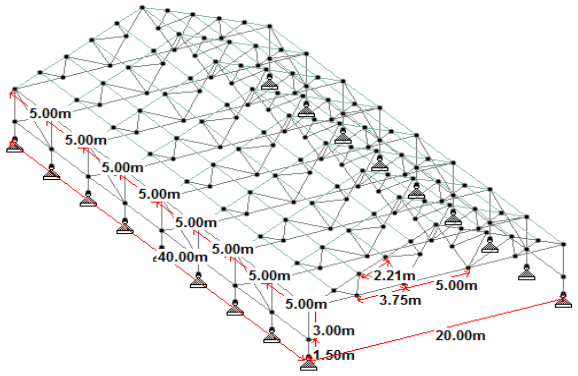


Fig-1

3.1.2 Modeling of the truss for 27.5˚ slope roof

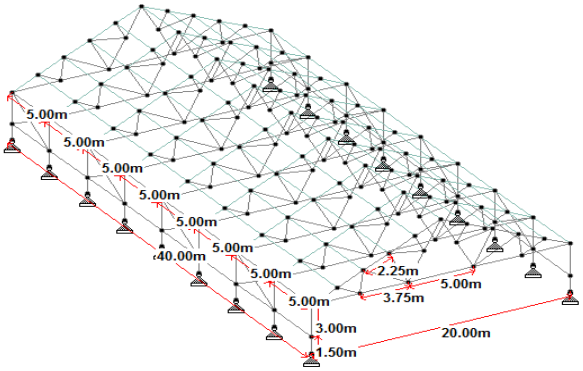


Fig-2

3.1.3 Modeling of the truss for 30˚ slope roof

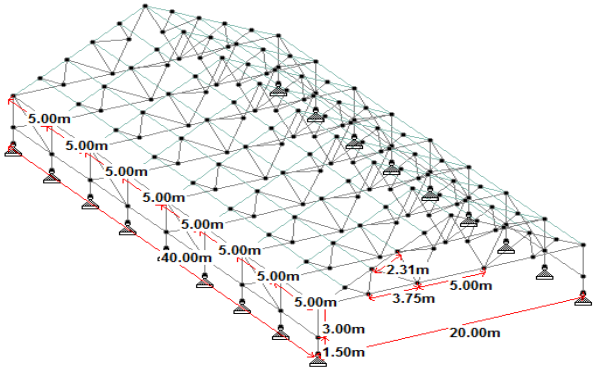


Fig-3

- ✓ The Quantity of steel for the Truss of 25˚ Slope Roof is 36954 kg
- ✓ The Quantity of steel for the Truss of 27.5˚ Slope Roof is 44613 kg

- ✓ The Quantity of steel for the Truss of 30˚ Slope Roof is 49814 kg

3.2 Modeling of fink truss using STAAD-Pro:

3.2.1 Modeling of the truss for 25˚ slope roof

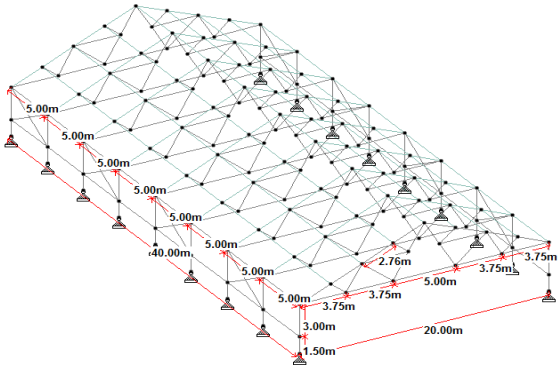


Fig-4

3.2.2 Modeling of the truss for 27.5˚ slope roof

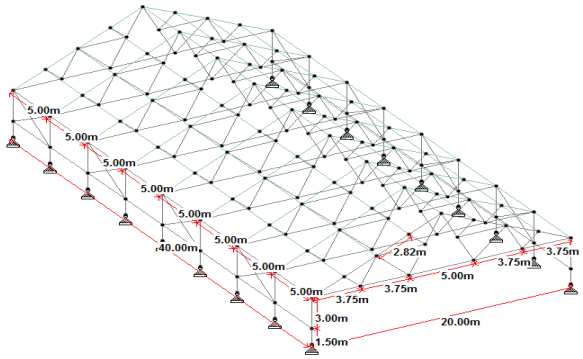


Fig-5

3.2.3 Modeling of the truss for 30˚ slope roof

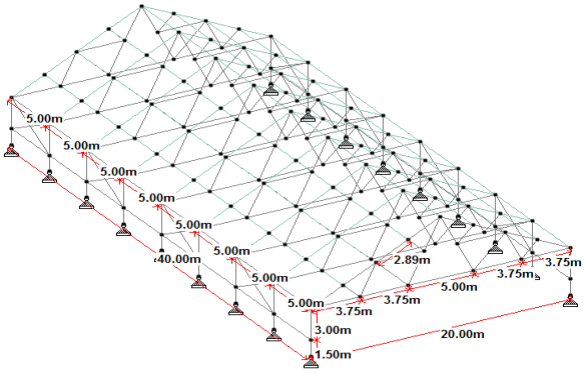


Fig-6

- ✓ The Quantity of steel for the Truss of 25˚ Slope Roof is 34652 kg
- ✓ The Quantity of steel for the Truss of 27.5˚ Slope Roof is 38692 kg
- ✓ The Quantity of steel for the Truss of 30˚ Slope Roof is 39913 kg

4.1 Modeling of fan truss using SAP-2000:

4.1.1 Modeling of the truss for 25˚ slope roof

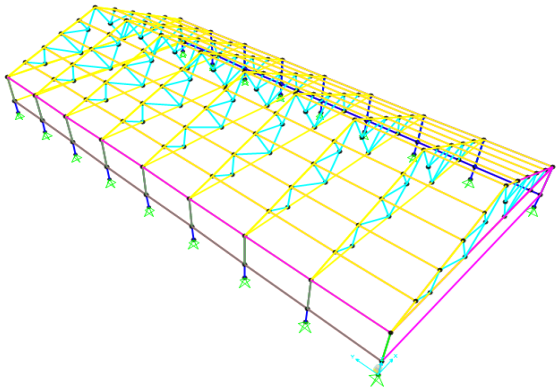


Fig-7

4.1.2 Modeling of the truss for 27.5˚ slope roof

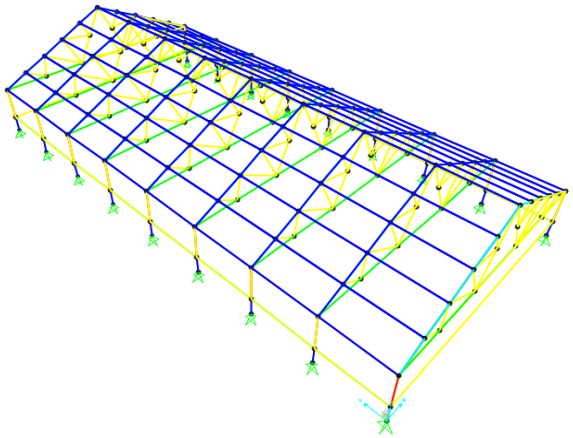


Fig-8

4.1.3 Modeling of the truss for 30˚ slope roof

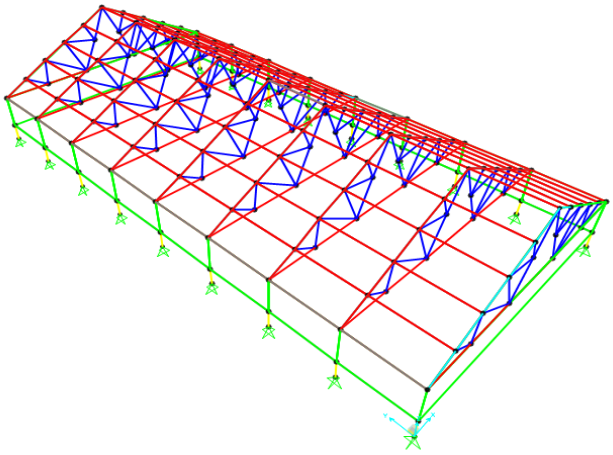


Fig-9

- ✓ The Quantity of steel for the Truss of 25˚ Slope Roof is 22197 kg
- ✓ The Quantity of steel for the Truss of 27.5˚ Slope Roof is 25213 kg
- ✓ The Quantity of steel for the Truss of 30˚ Slope Roof is 26159 kg

4.2 Modeling of fink truss using SAP-2000

4.2.1 Modeling of the truss for 25˚ slope roof

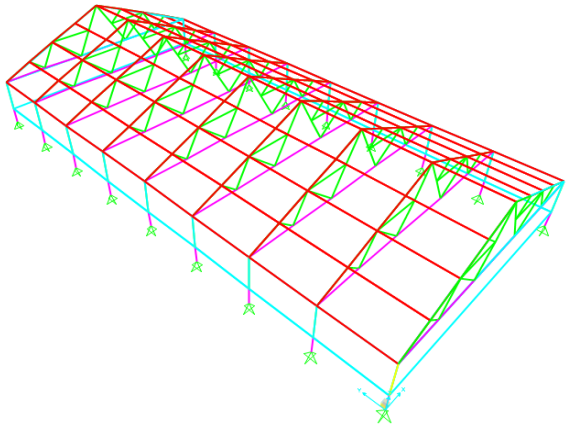


Fig-10

4.2.2 Modeling of the truss for 27.5˚ slope roof

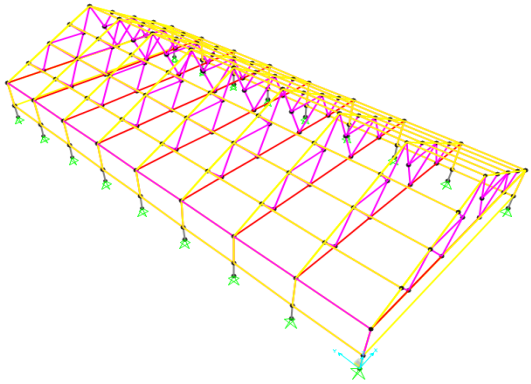


Fig-11

4.2.3 Modeling of the truss for 30˚ slope roof

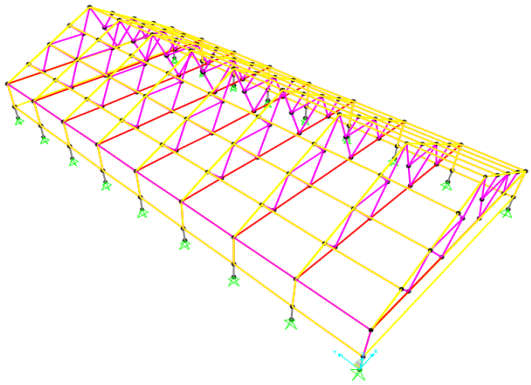
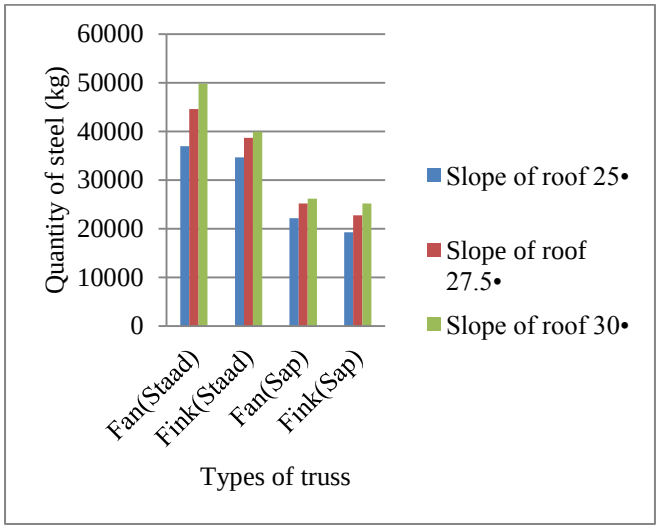


Fig-12

- ✓ The Quantity of steel for the Truss of 25˚ Slope Roof is 19285 kg
- ✓ The Quantity of steel for the Truss of 27.5˚ Slope Roof is 22756 kg
- ✓ The Quantity of steel for the Truss of 30˚ Slope Roof is 25206 kg



Graph-1

5. Future scopes

The present study on Optimization of trusses of warehouse has been carried out. However, it is proposed that future study needs to investigate the following aspects related to the present analysis and design.

1. Software's like E-TABS, TECLA, ANSYS can also be used for analysis and design of the warehouse.
2. Truss configuration and Slope of roof can be modified.
3. Design the structure for future expansion or addition of other components like crane, mezzanine on it.
4. Other international codes can be used for analysis and design.

6. Conclusions

The quantity of steel varies in both the software's, it's because STAAD-Pro works in **Stiffness Method** and SAP-2000 works in **Finite Element Method.** While comparing the results of FAN and FINK truss of roof slopes of 25•, 27.5• and 30• in STAAD Pro and SAP-2000. The authors find out that fan and fink truss 25• roof slope gives optimum usage of steel. After obtaining the above results and comparing them among the fan and fink truss at 25• roof slope, the authors concluded that the Fink truss at 25• roof slope produces the best results in giving the optimum usage of steel for warehouse constructions.

7. References

1. V.N.Vazirani, M.N.Ratwani, "Analysis and Design of steel structures", Khana publications, Delhi, 1967.
2. Dr.P.Dayaratnam, "Design of steel structures", Schand and Company Ltd, March 1998.
3. N.Subramanian, "Design of steel structures", Oxford University Press, 2010.
4. IS:800:2007." Code of Practice for use of Structural steel in General Building Constructions", Bureau of Indian Standards, New Delhi.
5. IS:456-2000, "Code of Practice for Plain and Reinforced Concrete".
6. Nikhil B. Fultariya, "Weight Optimization of Steel Roof Truss with Different Types, Spans & Slopes of Roof".
7.Er.SanjeevKumar, BrahmjeetSingh, Er. BhupinderSingh, "Optimization of Roof Truss Using STAAD-Pro".
8.Er. Gurinder Kaur, Er. Rajwinder Singh Bansal, Er. Sanjeev Kumar, "Shape Optimization of Roof Truss".