IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 14, Issue 6 Ver. II (Nov. - Dec. 2017), PP 09-14
www.iosrjournals.org

Analysis of Double Howe Steel Truss & Cantilever Truss Using Ansys Software

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Abstract: *Analysis of any fames (or) truss by conventional method is very difficult and time consuming process which may leads to error in calculation of results. In order to overcome this problem most of them will use ANSYS software to analyze the frames and truss cases. ANSYS is general purpose software used to simulate interactions of all disciplines of physics, structural, vibrations, fluid dynamics, heat transfer and electromagnetic uses for engineers. In this paper analysis of double Howe steel truss and cantilever truss are carried out and the results of nodal deflections, stresses in elements for both cases were determined.*

Date of Submission: 08 -11-2017 Date of acceptance: 30-11-2017

I. Introduction

A truss, or lattice structure, is a structural assembly of small interconnected elements. Trusses are formed by an interconnected assembly of relatively small elements, which create a lattice arrangement. The overall form, size and shape of the truss are as important as the strength of the individual components, and a wide variety of design options is available. A truss acts like a beam, with bending resisted by the couple created by forces in the top and bottom members. (MaGinley, 1998). The choice of cross-sectional shape for individual members of trusses is not restricted. Whereas beam members are predominantly I-shaped to accommodate the bending effects, truss members are generally subject to small direct forces. Consequently angles, tees, or any other standard structural section may be used. For lightly loaded structures the members are usually angles or tees while for more heavily loaded trusses universal beam sections may be more appropriate. Open sections make the connections simpler but when aesthetic considerations are important, circular and rectangular hollow sections are commonly used along with welded joints providing neat details.

Trusses are triangular frame works in which the members are subjected to essentially axial forces due to externally applied load. They may be plane trusses, wherein the external load and the members lie in the same plane or space trusses, in which members are oriented in three dimensions in space and loads may also act in any direction. Trusses are frequently used to span long lengths in the place of solid web girders and such trusses are also referred to as lattice girders. Steel members subjected to axial forces are generally more efficient than members in flexure since the cross section is nearly uniformly stressed.

Trusses, consisting of essentially axially loaded members, thus are very efficient in resisting external loads. They are extensively used, especially to span large gaps. Since truss systems consume relatively less material and more labour to fabricate, compared to other systems, they are particularly suited in the Indian context. A truss is essentially a triangulated system of straight interconnected structural elements. Trusses are widely used in buildings, whereas to support roofs, the floors and internal loading such as services The main reasons for using trusses are to obtain long span and reduction of self-weight and deflection of the structure. Trusses comprise assemblies of tension and compression elements. Under gravity loads, the top and bottom chords will resist bending and the bracing resists the shear forces. The choice of cross-sectional shape for individual members of trusses is not restricted. Whereas beam members are predominantly I-shaped to accommodate the bending effects. Truss members are generally subject to small direct forces. Consequently angles, tees, or any other standard structural section may be used. For lightly loaded structures the members are usually angles or tees while for more heavily loaded trusses universal beam sections may be more appropriate. Open sections make the connections simpler but when aesthetic considerations are important, circular and rectangular hollow sections are commonly used along with welded joints providing neat details.

II. ANSYS Software

ANSYS is a general purpose software, used to simulate interactions of all disciplines of physics, structural, vibration, fluid dynamics, heat transfer and electromagnetic for engineers. So ANSYS, which enables to simulate tests or working conditions, enables to test in virtual environment before manufacturing prototypes of products. Furthermore, determining and improving weak points, computing life and foreseeing probable problems are possible by 3D simulations in virtual environment. ANSYS software with its modular structure as seen in the table below gives an opportunity for taking only needed features. ANSYS can work integrated with other used engineering software on desktop by adding CAD and FEA connection modules.

ANSYS can import CAD data and also enables to build geometry with its "preprocessing" abilities. Similarly in the same preprocessor, finite element model (a.k.a. mesh) which is required for computation is generated. After defining loadings and carrying out analyses, results can be viewed as numerical and graphical. ANSYS can carry out advanced engineering analyses quickly, safely and practically by its variety of contact algorithms, time based loading features and nonlinear material models. ANSYS Workbench is a platform which integrates simulation technologies and parametric CAD systems with unique automation and performance. The power of ANSYS Workbench comes from ANSYS solver algorithms with years of experience. Furthermore, the object of ANSYS Workbench is verification and improving of the product in virtual environment. ANSYS Workbench, which is written for high level compatibility with especially PC, is more than an interface and anybody who has an ANSYS license can work with ANSYS Workbench. As same as ANSYS interface, capacities of ANSYS Workbench are limited due to possessed license.

III. Loads on Trusses

Dead Load:

Dead load on the roof trusses in single storey industrial buildings consists of dead load of claddings and dead load of purlins, self-weight of the trusses in addition to the weight of bracings etc. Further, additional special dead loads such as truss supported hoist dead loads, special ducting and ventilator weight etc. could contribute to roof truss dead loads. As the clear span length (column free span length) increases, the self-weight of the moment resisting gable frame increases drastically. In such cases roof trusses are more economical.

Live Load:

The live load on roof trusses consist of the gravitational load due to erection and servicing as well as dust load etc. and the intensity is taken as per IS:875 Additional special live loads such as snow loads in very cold climates, crane live loads in trusses supporting monorails may have to be considered.

Earthquake Load:

Since earthquake load on a building depends on the mass of the building, earthquake loads usually do not govern the design of light industrial steel buildings. Wind loads usually govern. However, in the case of industrial buildings with a large mass located at the roof, the earthquake load may govern the design. These loads are calculated as per IS: 1893- 2002.

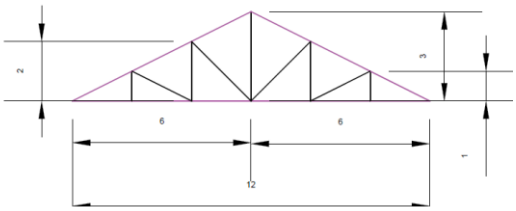
IV. Modeling and Analysis

Steps involved in designing of software:

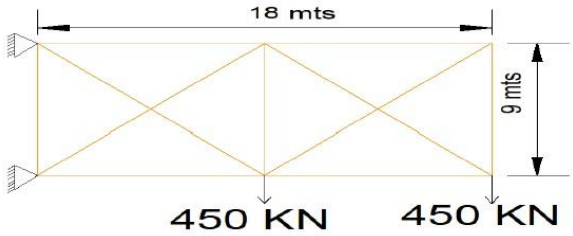
- Plot the line plan
- Define material.
- Assigning the material property to the members
- Meshing
- Support conditions
- Assigning loads
- Analysis of Structure

Models of Structures:

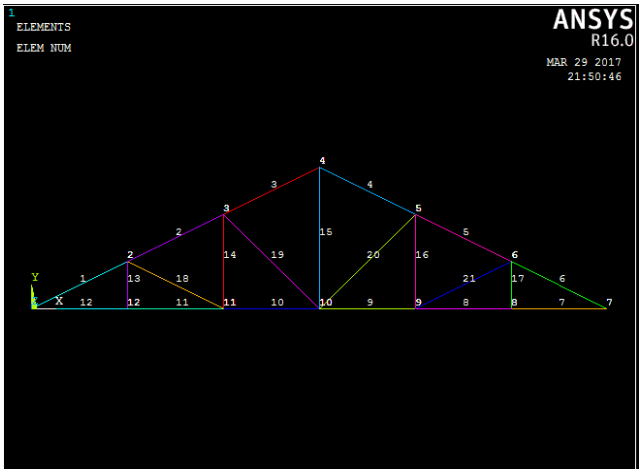
Double Howe Steel Truss



Cantilever Truss

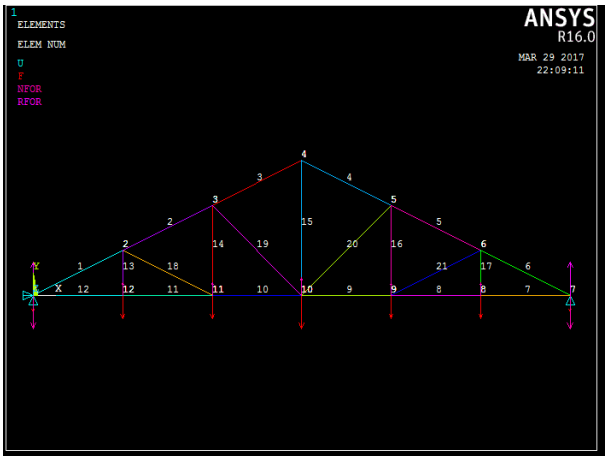


Model in ANSYS Software

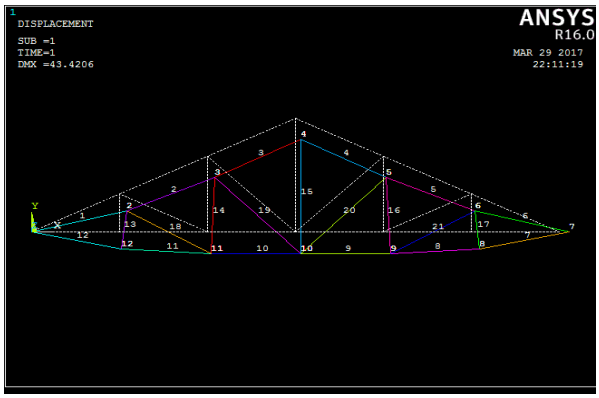


V. Results

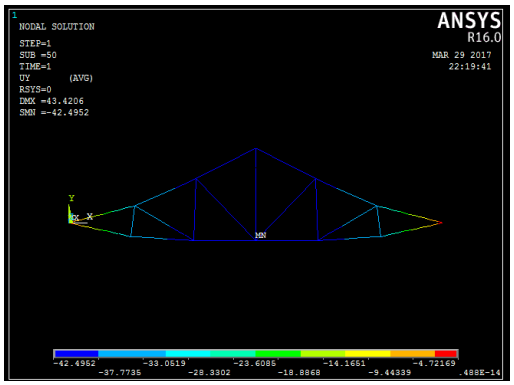
Loads on Truss



Deformed Shape



Deflection



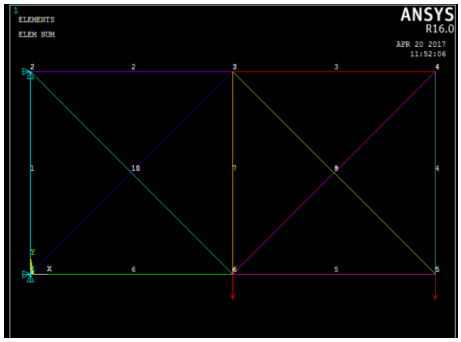
Nodal Deflections:

NODE	Ux(mm)	UY(mm)
1	0	0
2	11.763	-32.378
3	12.33	-40.732
4	8.9167	-39.495
5	5.5033	-40.732
6	6.0701	-32.378
7	17.833	0
8	14.667	-32.669
9	11.5	-41.607
10	8.9167	-42.495
11	6.3333	-41.607
12	3.1667	-32.669

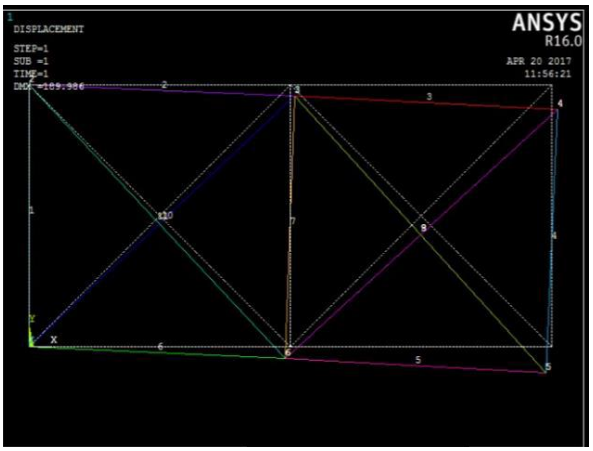
Stresses in Elements:

ELEMENT	STRESS
1	-354.04
2	-288.33
3	-223.61
4	-223.61
5	-288.83
6	-354.04
7	316.67
8	316.67
9	258.33
10	258.33
11	316.67
12	316.67
13	58.333
14	87.5
15	200
16	87.5
17	58.333
18	-65.219
19	-82.496
20	-82.496
21	-65.219

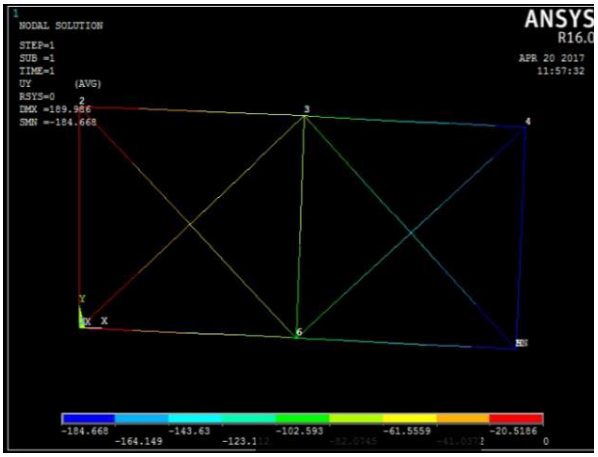
Cantilever Truss
Model in ANSYS Software



Deformed Shape



Deflection



Nodal Deflections:

NODE	Ux(mm)	UY(mm)
1	0.0000	0.0000
2	0.0000	0.0000
3	32.968	-78.485
4	39.739	-177.90
5	-44.636	-184.67
6	-34.532	-84.474

Stresses in Elements:

ELEMENT	STRESS
1	0
2	732.62
3	150.47
4	150.47
5	-224.53

6	-767.38
7	133.09
8	-212.79
9	317.54
10	-505.75
11	554.91

VI. Conclusion

By comparing double Howe steel truss with cantilever truss, double Howe steel truss is carrying more loads with less deflection. Hence cantilever steel truss can't be used for long span structures. Cantilever trusses can't be used for severe weather condition. By considering above conditions we can prefer double Howe steel truss.

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