Comparative Stress Analysis of Truss with and Without Bracing

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Abstract— In engineering, a truss is a structure consisting of members or elements that takes only tension or compression but no bending. It consists of two force members, where the members are organized so that the assemblage as a whole behaves as a single object. Two force members can be defined as a structural component where force is applied to only two points. In truss, bracing is a system generally used to reinforce the structures in which diagonal supports intersect. Bracing also increase load carrying capacity. In this paper a brief investigation is made on different kind of geometrical arrangement for one dimensional truss. These different geometrical arrangements of bracings are analyzed using FEM software package (STAAD PRO_2007) and compared the results (member stress) of each primary member of the truss (1D). From the study it was found that after providing bracing arrangement type-T3 (Fig-5) the strength of the truss (1D) is increased.

Key words: Truss (1D), Bracing, Different Geometrical arrangement of bracing, member deflection, member stress

I. INTRODUCTION

A truss is basically a framed structure formed by connecting various members at their end to form a two force member system. In industrial buildings, steel trusses are commonly used. Most of the time bracing used in truss structure to get support from later forces. In daily practice cross type of bracings are used in constructions. Though bracing system is not only used in trusses but also other structures, such as building frame, steel bridges, long spanned frame structures etc.. In this project a steel truss is modeled in FEM software (Staad pro 2007). In this investigation 6 type of bracing arrangements are designed and all the member of the truss and bracings are taken as 200×200 mm^2 square cross sectional. The aim of this research is to find out more suitable type bracing arrangement for improving the strength of the structure.

II. PHYSICAL PROPERTY

The physical property of the material which is used in this following analysis are given in Table: 1, this properties are taken from IS 800-2007.

Material	Steel
Modulus of Elasticity	2×10^5 N/mm^2
Poisson ratio	0.3
Density	76.8195 kg/m^3

Table 1: Property of Steel as Per Is: 800-2007.

III. TRUSS MEMBER SPECIFICATION

The Geometrical property of member (Fig-1) of the truss is given in Table-2.And the dimension of truss are given in figure 2.

Cross Section of the member	Square
Area	40000mm^2
Length	400mm,300mm
Moment of inertia	1.333×10^8mm^4

Table 2: Geometrical Property of Truss Member.

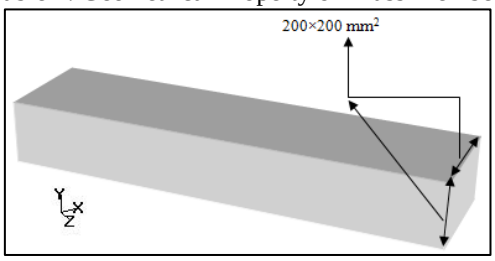

Fig. 1: Geometrical shape of element of the truss.

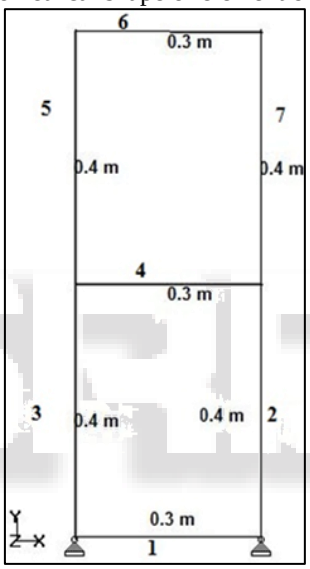

Fig. 2: Dimensions of the truss (T0).

There are six type of bracing arrangement modeled and analysis in STAAD PRO_2007. Dimensions and the arrangement of different type of bracings (T1, T2, T3, T4, T5, T6) are given in figure-3, figure-4, figure-5, figure-6, figure-7, and figure-8 respectively.

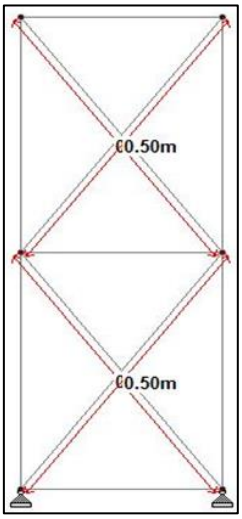

Fig. 3: T1 Truss

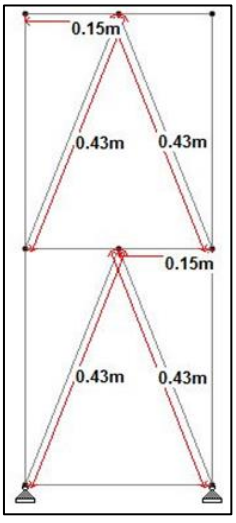

Fig. 4: T2 Truss

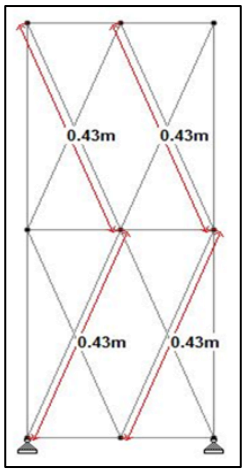

Fig. 5: T3 Truss

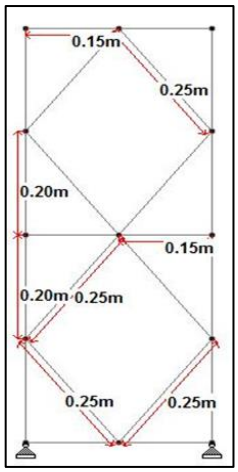

Fig. 6: T4 Truss

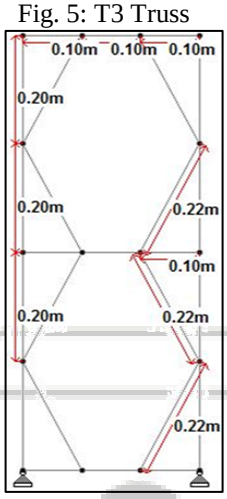

Fig. 7: T5 Truss

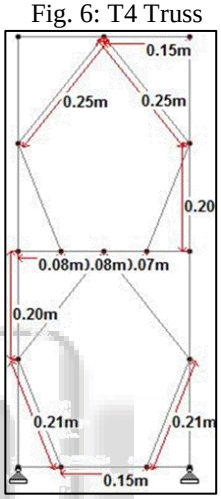

Fig. 8: T6 Truss

IV. METHODOLOGY

In this paper investigation is made to find out the maximum stress of each primary truss members are given below.

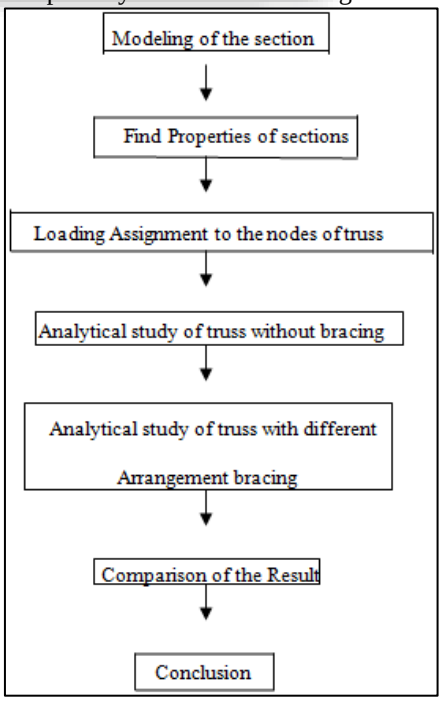

Fig. 9: Methodology Flow Chart

V. ANALYTICAL STUDY

For the analytical investigation, finite element method is used which is a numerical analysis technique for obtaining solutions of different engineering problems. Most of the engineering problems today make it necessary to obtain approximate numerical solution to problems rather than exact closed from solutions. The basic concept behind the finite element analysis method is discretization of structure where a structure is divided into a finite number of elements having finite dimensions and reducing the structure having infinite degrees of freedom to finite degrees of freedom. Then the original structures is assemblage of these elements connected at a finite number of joints called nodes. In this research work for finite element software package is STAAD PRO_2007 was being used. After modeling the truss with and without bracing, STAAD PRO_2007 program performances series of simultaneous equations generated from the element model and corresponding results of member stresses due to applying 24kN and 12kN lateral load towards (+ve) X direction and 80kN concentrated load towards (–ve)Y direction, in node d, f, g respectively, shown figure 10.Supports of the truss with and without bracings are given pinned support in node a, b respectively.

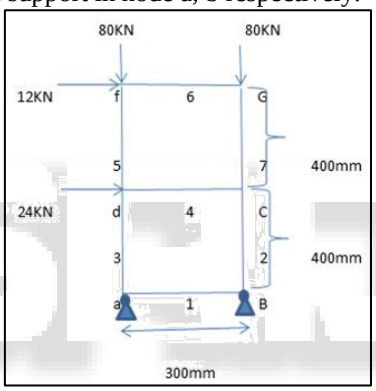

Fig. 10: Loading pattern and pinned support condition of truss with or without bracing.

VI. ANALYTICAL RESULT

After providing the bracing in truss stress in each main member which is mentioned in figure-10, given in table-3

	T0-S N/mm^2	T1-S N/mm^2	T2-S N/mm^2	T3-S N/mm^2	T4-S N/mm^2	T5-S N/mm^2	T6-S N/mm^2
M 1	0	0	0	0	0	1×10^{-4}	-0.0171
M 2	2	2.205	2.0105	1.5309	4.7035	4.2656	4.4694
M 3.	2	0.4698	0.9046	0.3088	1.4073	1.2602	1.4239
M 4	0.6	-0.432	0.4015	0.2632	0.1355	0.6509	0.6787
M 5	2	1.1899	1.3826	0.7801	2.6997	2.4355	2.5944
M 6	0.3	-0.2707	0.1399	-0.2914	-0.0082	0.091	0.0439
M 7	2	1.5324	1.5643	1.0672	3.4115	3.0891	3.2744

Table 3: Stress results of truss members

S-without bracing truss, T1,T2,T3,T4,T5,T6-with bracing trusses.

VII. Comparison of Results

From the analytical investigation, comparative results are shown in the Figure 11. From the Figure-11 it is clearly shown that stress in T4, T5, T6 type of truss is increased compared to the without bracing truss T0.

We also see member stress of T1 and T2 type truss did not increased comparatively T0 type of truss. But the stress in T3 type of truss has experienced less stress compared to all the type of truss with or without bracing.

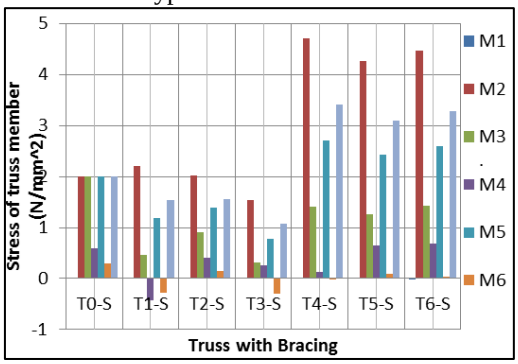

Fig. 11: Comparison of stress of truss member with and without bracings

VIII. Conclusion

In this paper the studies on stress analysis of with or without bracing truss is presented. From the analytical study on different arrangement of bracing of truss, following conclusion can be drawn.

- T3 type of truss has more strength and load carrying capacity.
- We provide bracing to reduce stress in member form lateral and concentrated load. But for T4,T5 and T6 type of truss the stress increased

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