Analysis of Truss System for Industrial Structure

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Abstract— In a developing country like India, the capital outlay under each Five-Year Plan towards setting up of industries and consequently construction of industrial buildings is very high. It is, therefore, necessary that the various parameters of industrial buildings be standardized on broad norms so that it would be feasible to easily adopt prefabricated members, particularly where repetitive structure could be used. In the present work, a total of ten pitched roof trusses are compared. The analysis and design results of steel roof trusses are presented for a span of 12 m and 6 m spacing between them. The truss configurations used are Double Howe, Double Fink, Fan, Fink, Pratt, Queen post, Fink-2, Multi panel, Attic and Piggyback. The slope of roof truss provided is 180 which is generally recommended as this may not pose any fabrication problem. The analysis of roof truss is done for wind zones I to VI. The analysis and design have been done based on the relevant Indian standards. Box sections are used in trusses. A comparison of axial force, shear force in members and weight and cost are made. Also, axial and shear force on these trusses is compared. The result shows that the Pratt truss is more economical than other trusses considered. On the other hand, Fink-2 type truss is costlier and has more weight than other trusses.

Keywords: Industrial Roof Trusses, Wind Loading

I. INTRODUCTION

A "truss" is formed when structural members are joined together in triangular configurations. The truss is one of the basic types of structural frames formed from structural members. A truss consists of a group of ties and struts designed and connected to form a structure that acts as a large span beam. The members usually form one or more triangles in a single plane and are arranged; the external loads are applied at the joints and therefore theoretically cause axial tension or axial compression in the members. The members are assumed to be connected at their joints with frictionless hinges or pins that allow the ends of the members to rotate slightly. Because the members in a truss are assumed to be connected to frictionless pins, the triangle formed is the only stable shape.

A. ROOF TRUSSES

Trusses are used in a variety of applications where a lightweight, yet strong, structure is required. Trusses are used extensively in bridges, buildings (particularly roofing and flooring), radio and television towers and space-based constructions.

Many home builders order prefabricated roof trusses from a manufacturer and have them delivered to a building site because building roof trusses are labour intensive and prefabricated roof trusses save time, materials, and money.

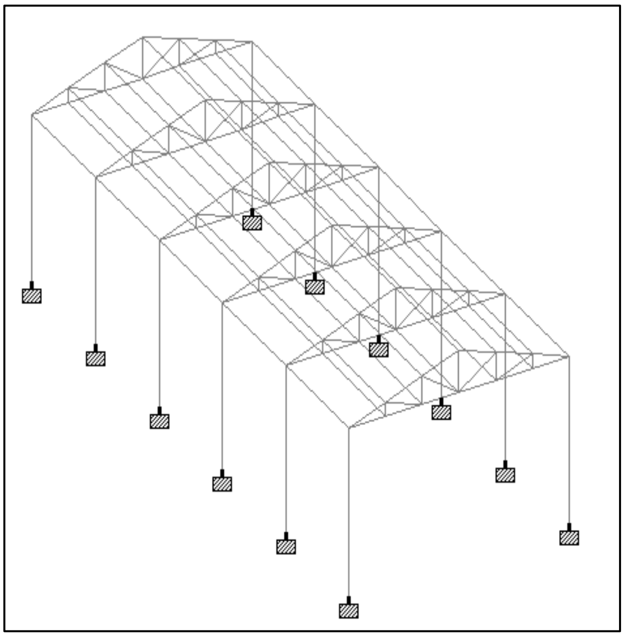

Fig. 1 Industrial Truss system

II. OBJECTIVE OF STUDY

The following are the objectives of the current study-

1) To analyze different steel roof trusses i.e., Double Howe, Double Fink, Fink, Queen Post, Fan, Fink-2, Pratt, Multi panel, Atticand Piggyback using STAAD Pro.
2) To analyze different types of steel roof trusses of span 12m and spacing of 6m for wind zones I, II, III, IV, V and VI.
3) To compare axial forces of typical members, principal rafter, tie member and web members (strut and vertical) in steel roof trusses.
4) To compare shear force of typical members, principal rafter, tie member and web members (strut and vertical) in steel roof trusses.
5) To compare trusses with reference to weight and cost.

III. METHODOLOGY

This project involves analysis and design using a popular designing software STAAD Pro. STAAD Pro was chosen because of its following advantages.

1) Easy to use interface,
2) Conformity with the Indian Standard Codes,
3) Versatile nature of solving any type of problem, and
4) Accuracy of the solution

IV. Results

A. Axial Forces in Different Members of Different Trusses in Wind Zone I.

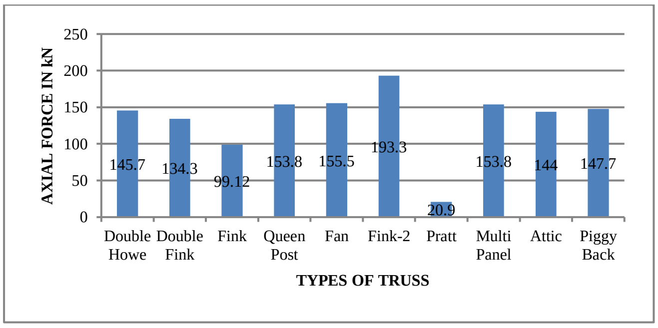

Fig. 2: Comparison of Axial Forces in Principal Rafter.

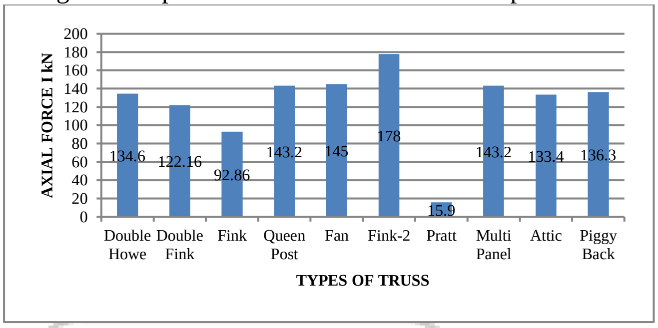

Fig. 3: Comparison of Axial Forces in Ties

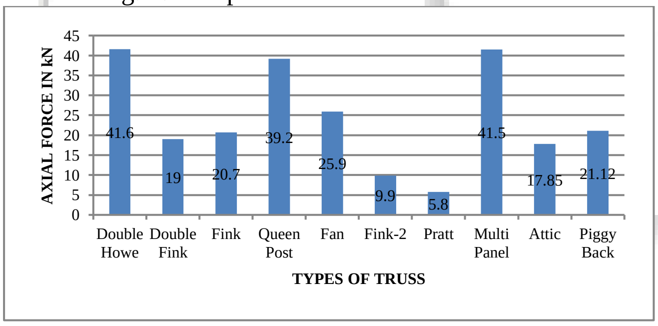

Fig. 4: Comparison of Axial Forces in Webs (Inclined Members)

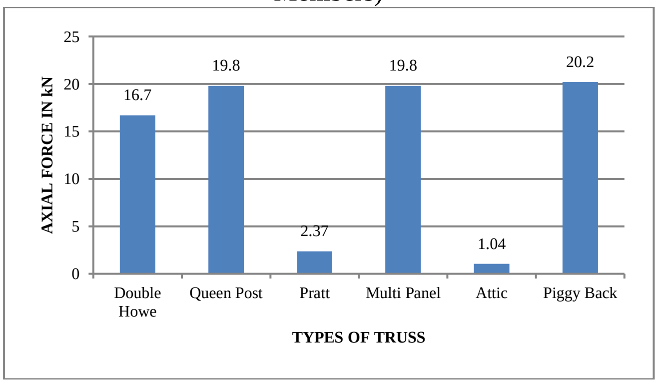

Fig. 5: Comparison of Axial Forces in Webs (Vertical Members)

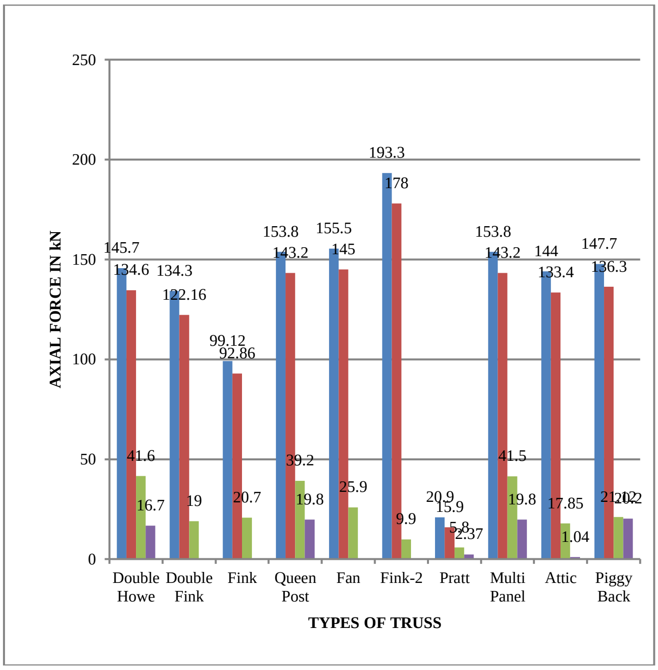

Fig. 6: Comparison of Axial Forces for Typical Members in Different Types of Trusses

B. Axial Forces in Different Members of Different Trusses in Wind Zone II

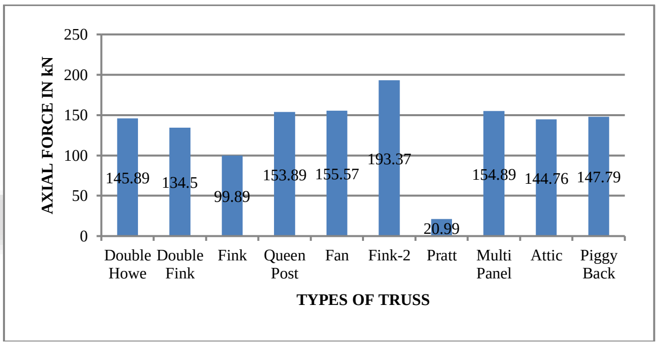

Fig. 7: Comparison of Axial Forces in Principal Rafter

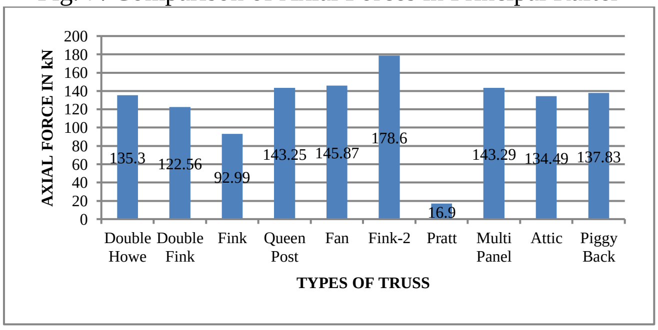

Fig. 8: Comparison of Axial Forces in Ties

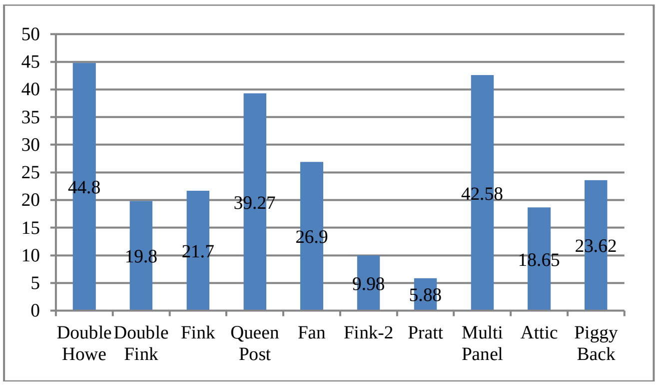

Fig. 9: Comparison of Axial Forces in Webs (Inclined Members)

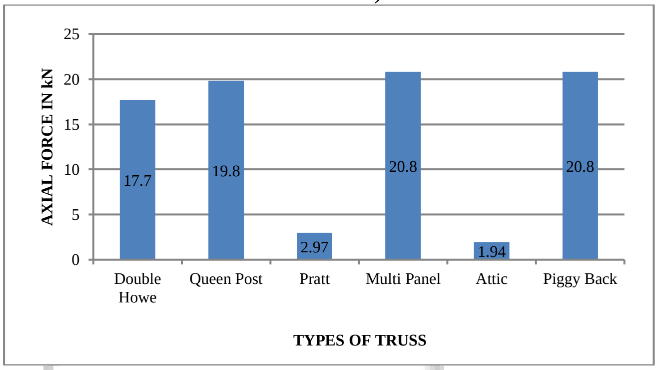

Fig. 10: Comparison of Axial Forces in Webs (Vertical Members)

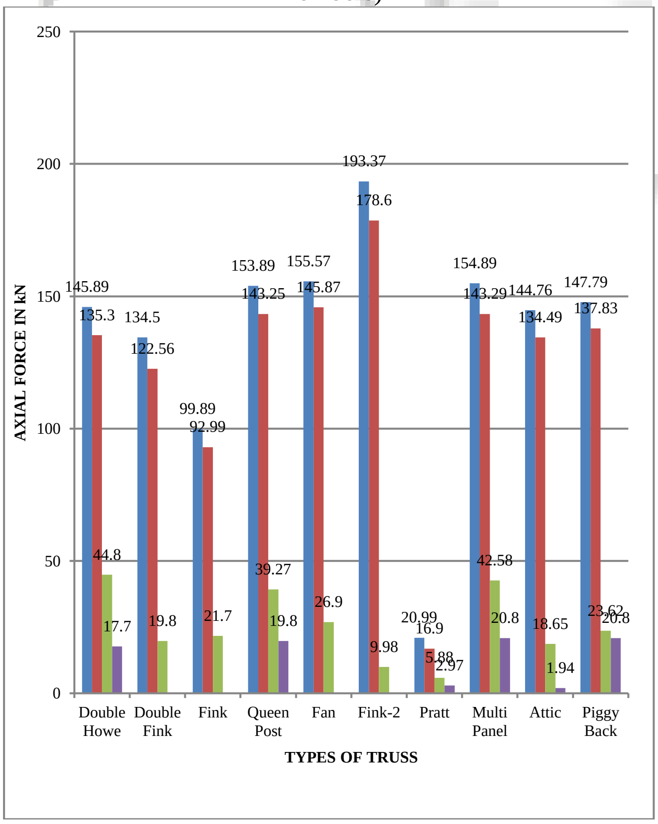

Fig. 11: Comparison of Axial Forces for Typical Members in Different Types of Trusses

C. AXIAL FORCES IN DIFFERENT MEMBERS OF TRUSSES IN WIND ZONE III

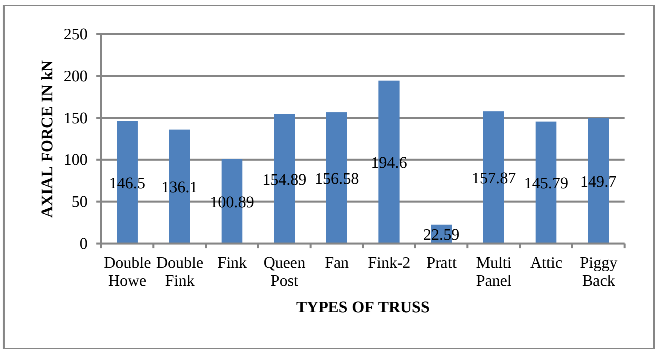

Fig. 12: Comparison of Axial Forces in Principal Rafter

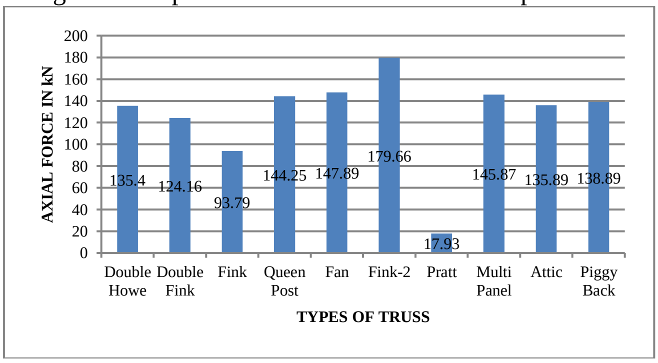

Fig. 13: Comparison of Axial Forces in Ties

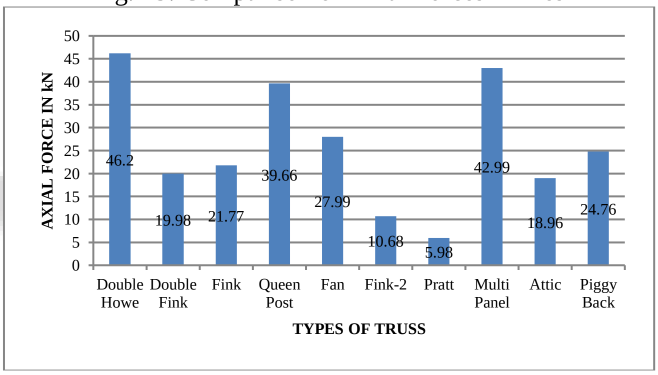

Fig. 14: Comparison of Axial Forces in Webs (Inclined Members)

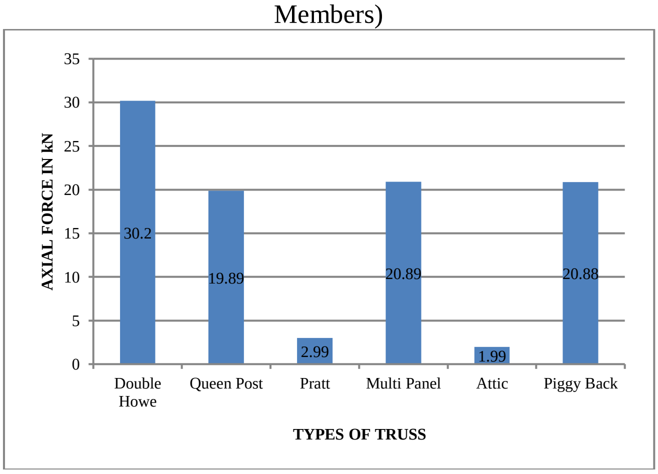

Fig. 15: Comparison of Axial Forces in Webs (Vertical Members)

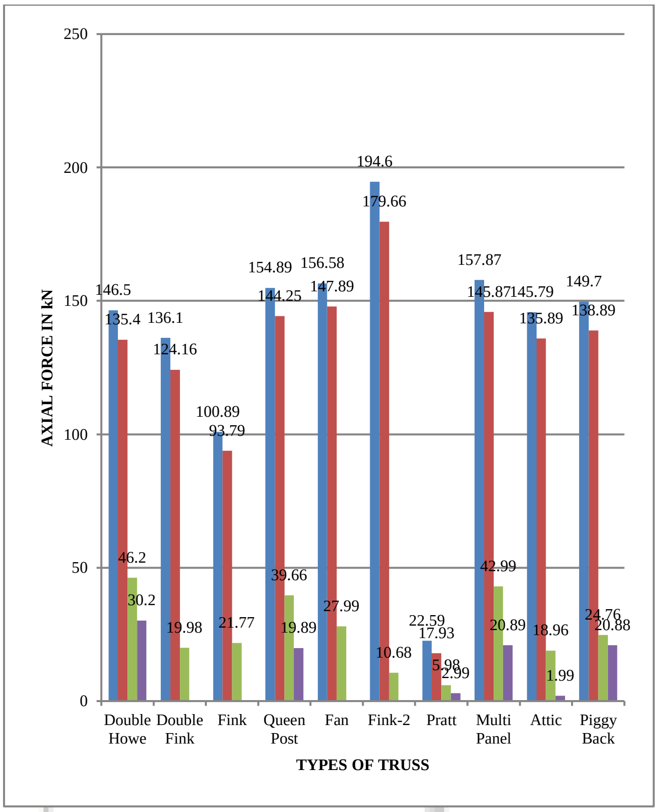

Fig. 16: Comparison of Axial Forces for Typical Members in Different Types of Trusses

V. CONCLUSION

- Weight of Fink-2 type truss is more than other trusses considered for the same span.
- Similarly, comparing truss based on cost, Fink type truss is costlier than other trusses.
- Weight and cost of Pratt truss is found to be less than that of other trusses.
- Weight of Fink-2 type truss varies from wind zone I to VI. It is about 59.4%, 61.2%, 64.2%, 66.2% and 69% of weight of truss for wind zone VI, respectively.

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