IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

COMPARATIVE STUDY OF HOT ROLLED AND COLD FORMED STEEL TRUSS

Mr.Ahmed Mohd Mustafa[1], Mr. Ganesh C. Jawalkar[2], Mr. Pradeep P. Tapkire[3]

[1]Student, Department of Civil Engineering, N.B. Navale Sinhagad College of Engineering, Solapur - 413255

[2]Associate Prof., Dept. of Civil Engineering, N.B. Navale Sinhagad College of Engineering, Solapur - 413255

[3]HOD, Dept. of Civil Engineering, N.B. Navale Sinhagad College of Engineering, Solapur - 413255

Abstract

This study conducts a comparative design analysis of hot rolled and cold formed steel trusses, focusing solely on structural performance considerations. Understanding the design nuances between these two truss types is crucial for optimizing structural efficiency and reliability in construction projects.

The study begins by delineating the distinct design methodologies applicable to hot rolled and cold formed steel trusses, highlighting key differences in material properties, manufacturing processes, and structural behavior. Through analytical modeling and computational simulations, the structural performance of truss systems is rigorously evaluated under various loading scenarios.

Critical design parameters such as member sizes, span lengths, and overall geometry are scrutinized to ascertain their impact on structural strength, stiffness, and stability. By examining these factors comprehensively, the study aims to identify optimal design configurations for hot rolled and cold formed steel trusses, thereby enhancing their structural efficiency and effectiveness.

The findings of this research provide valuable insights into the design considerations inherent to hot rolled and cold formed steel trusses, enabling engineers and designers to make informed decisions regarding the selection and optimization of truss systems in construction projects. By focusing solely on structural performance, this study contributes to the advancement of efficient and reliable structural designs utilizing steel trusses. The sections are selected based on the moment capacity and effective span of the sections by software STAAD.Pro. The analytical results are compared according to Indian and European Standards.

1.1 Preamble

Cold-formed steel sections are commonly used in civil construction as both secondary and in contemporary construction practices, the choice between cold-formed and hot-rolled steel trusses plays a pivotal role in determining the overall efficiency, durability, and cost- effectiveness of a structural system. Understanding the fundamental disparities between these fabrication methods is crucial for architects, engineers, and developers aiming to achieve the desired balance between performance, aesthetics, and budgetary considerations.

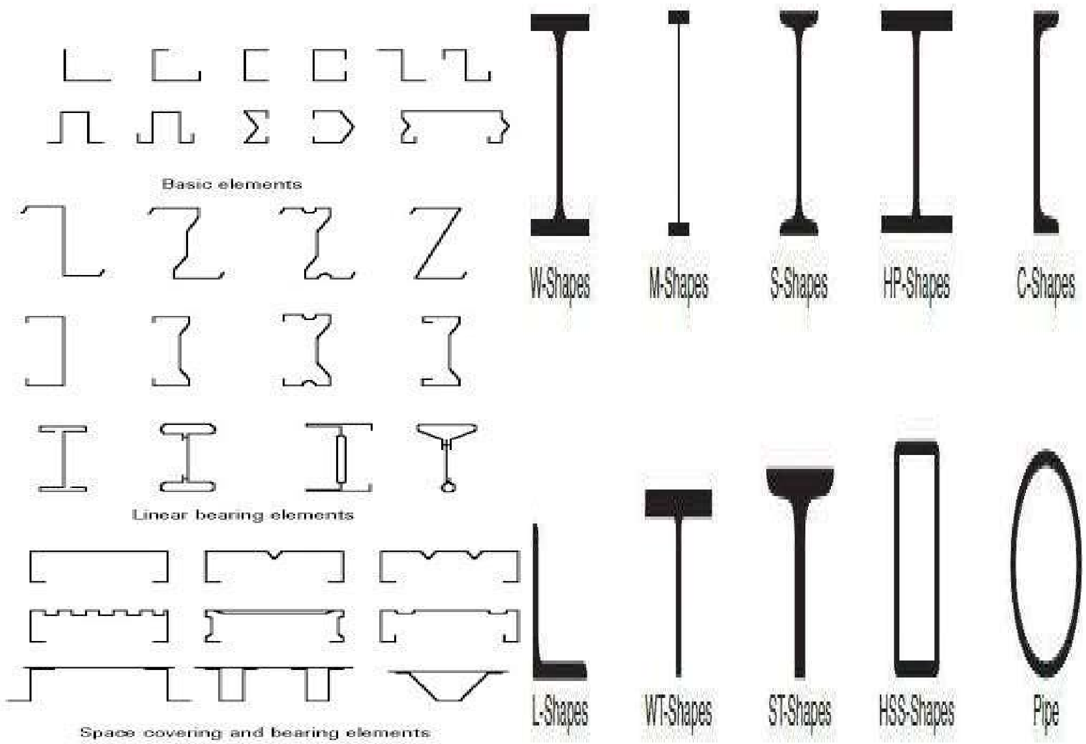
Cold-formed steel trusses are crafted through a process of bending sheet or strip steel at room temperature, typically using press brakes or roll-forming machines. This method allows for precise customization of dimensions and shapes, making cold-formed trusses particularly suitable for intricate designs and architectural expressions. Moreover, the cold-forming process imparts excellent dimensional accuracy and consistency, resulting in uniformity across truss members and connections.

On the other hand, hot-rolled steel trusses are manufactured by heating steel billets or ingots to high temperatures and passing them through rollers to achieve the desired shape and dimensions. This process induces significant plastic deformation, enhancing the material's structural integrity and load-bearing capacity. Hot-rolled trusses often exhibit superior strength and stiffness compared to their cold-formed counterparts, making them ideal for heavy-duty applications such as industrial facilities, bridges, and high-rise buildings.

In terms of structural performance, cold-formed steel trusses excel in applications where weight reduction, ease of installation, and design flexibility are paramount. Their lightweight nature minimizes transportation costs and simplifies on-site assembly, while their adaptability allows for swift modifications to accommodate evolving project requirements. Additionally, advancements in cold-formed steel manufacturing technologies have led to innovations in connection methods and material coatings, further enhancing the corrosion resistance and longevity of cold-formed trusses.

Conversely, hot-rolled steel trusses offer unmatched strength-to-weight ratios and inherent resistance to buckling and deformation under heavy loads. Their robustness makes them well- suited for projects requiring long-span solutions, such as stadiums, warehouses, and aircraft hangars. Although hot-rolled trusses may entail higher initial material costs and fabrication complexities, their superior performance characteristics often justify the investment, particularly in applications where structural integrity and safety are paramount concerns.

Some of the commonly available steel sections available are shown below:



1.2 Significance of Research Study

The significance of this thesis is multifold, as it delves into the design disparities between hot rolled and cold formed steel trusses while considering the application of various structural design codes. The aspects mentioned elucidates the importance of this study:

Holistic Comparison of Design Approaches: By examining both hot rolled and cold formed steel trusses, the thesis provides a comprehensive comparison of design methodologies. This holistic approach enables engineers and designers to understand the structural performance differences between the two types of trusses under various loading conditions.

Code-Based Analysis: Incorporating different structural design codes such as the Indian, Eurocode, or other relevant standards allows for a thorough evaluation of design practices. By assessing how each design approach aligns with different codes, the thesis offers insights into the implications of code selection on truss design, ensuring compliance with regional or international regulations.

Cross-Validation of Design Principles: The utilization of multiple design codes facilitates a cross-validation of design principles for hot rolled and cold formed steel trusses. This approach helps identify areas of convergence and divergence between codes, enabling engineers to make informed decisions when selecting appropriate design methodologies for specific project requirements.

Global Applicability and Standardization: Considering various design codes ensures that the findings of the thesis are globally applicable. Engineers and designers from different regions can benefit from the insights gained, fostering standardization and harmonization of design practices across geographic boundaries.

Enhanced Structural Safety, Reliability, and Cost-Effectiveness: Scrutinizing the application of different design codes contributes to enhancing not only structural safety and reliability but also cost-effectiveness. Understanding how design choices impact compliance with industry standards and their associated costs helps mitigate risks associated with structural failures while ensuring optimal use of resources and minimizing overall project costs.

Educational and Professional Advancement: Serving as an educational resource, the thesis aids in the professional development of students, academics, and practicing engineers. By showcasing real-world examples of code-compliant truss designs, the research equips individuals with the knowledge and skills necessary to navigate complex design challenges in structural engineering practice.

In essence, by examining hot rolled and cold formed steel truss design using different structural design codes, this thesis offers valuable insights that advance the field of structural engineering, promote global standardization, and contribute to the development of safer, more efficient and economical structural systems.

1.3 Aim & Objective

Aim

Comparative study of analysis and design of Hot Rolled and Cold Formed Steel Trusses for different spans by using different codes.

Objectives

- Analysis of Hot Rolled and Cold Formed Steel Truss for various Configurations with same span.
- Analysis of Hot Rolled and Cold Formed Steel Truss Configurations for different spans.
- Design of Hot Rolled and Cold Formed Steel Truss Configurations using various codes
- Cost Comparison of Hot Rolled and Cold Formed Truss Configurations.

1.4 Layout of Thesis

The thesis presentation has been organized in six chapters.

In Chapter 1, brief introduction and significance of the present research along with aim, objectives and the scope of research is presented. Layout of thesis is also presented in this chapter.

Chapter 2 explains the literature review related to the problem under consideration. Summary of literature review and gap in the literature studied are included in this chapter.

Chapter 3 titled as 'Theoretical Formulation', gives the flow of the current research. It contains details of physical and material properties, loading conditions etc.

Chapter 4 gives detail of analytical study research methodology of current research work.

Chapter 5, 'Results and Discussions' deals with validation of results obtained analytically by results obtained experimentally. This chapter includes discussion on requirement various parameters and percentage of forces. The effect of various equal and unequal spans with respect to different standards are recorded in this chapter.

In chapter 6, conclusions of the research work along with recommendations for optimization and choosing economical span pre planning of structures.

In chapter 7, Scope for future work.

Bibliography and details of research publications based on the research work is given at the end.

3.1 General

Since the usage of foreign code such as ACI 318. BS8110, EN 1993-2005 is getting common in India as more and more multi-national companies have opened there back-end offices in India which has led to research on comparative study between various codes.

Current Problem formulation includes the behaviour of trusses and their importance with respect to different codes for different spans. The structural modeling analysis procedure by software is also included in this chapter.

3.2 Comparison of Design Methodology of Hot Rolled and Cold Formed Sections:

Hot rolled and cold formed steel are two distinct manufacturing processes that result in structural steel with different characteristics, which consequently affect their design methodologies. Let's compare the structural design methodologies of both:

Hot Rolled Steel:

Material Properties:

Hot rolled steel is produced at high temperatures, resulting in a material with a more ductile and malleable nature. It typically has larger cross-sectional areas and thicker gauges.

Design Methodology:

Capacity Design: Hot rolled sections are typically designed using capacity-based design methods, where the strength of the member is derived from its yield and ultimate capacities. **Allowable Stress Design (ASD)**: This method allows designers to use a fraction of the material's yield strength as the allowable stress in the design. However, it's less common in modern design practices.

Load Resistance Factor Design (LRFD): This method utilizes load and resistance factors to determine the allowable strength of the member. It's widely used in modern steel design.

Cold Formed Steel:

Material Properties:

Cold formed steel is produced at room temperature or slightly elevated temperatures, resulting in thinner gauges and smaller cross-sectional areas compared to hot rolled steel. It tends to have higher strength but lower ductility compared to hot rolled steel.

Design Methodology:

Direct Strength Method (DSM): DSM is commonly used for cold formed steel design. It directly models the structural behavior of the member under load without reliance on traditional elastic analysis methods.

Effective Width Method: This method is used to determine the effective width of cold formed members for flexural and shear design calculations.

LRFD: Similar to hot rolled steel, LRFD is often used in cold formed steel design to determine the ultimate strength of the member considering load and resistance factors.

Comparison:

Complexity: Hot rolled steel design may involve more complex analyses due to its ductile behavior and larger cross-sectional areas, while cold formed steel design often relies on simplified methods tailored to its unique material properties.

Material Efficiency: Cold formed steel sections often provide higher strength-to-weight ratios, making them more material-efficient for certain applications compared to hot rolled steel.

Manufacturing Considerations: Cold formed steel design needs to consider manufacturing constraints such as material thickness variations and cold work effects, which may not be as significant in hot rolled steel design.

In summary, while both hot rolled and cold formed steel have their unique design methodologies, understanding the differences in material properties, manufacturing processes, and structural behaviors is crucial for effective and safe structural design

3.3 LOADING DETAILS.

The following are the set loads which have been considered in the design of Trusses

LOAD DATA: -

Live Load		=	0.75	KN/Sqm
Roof Sheeting & Finishes Load		=	1	KN/Sqm
Wind Load				
Basic Wind Speed	Vb	=	44	m/sec
Risk Coefficient	K1	=	1	
Terrain Category		=	III	
Terrain roughness & Height factor	K2	=	0.97	
Topography Factor	K3	=	1	
Importance Factor	K4	=	1.15	
Design Wind Speed	Vz max	=	Vb x K1 x K2 x K3 x K4	
		=	49.08	m/s
Design Wind Pressure (max)	Pz max	=	$0.6\ Vz^2$	
		=	1445.43	N/Sqm.
Wind Directionality Factor,	Kd	=	0.9	
Area Averaging Factor,	Ka	=	0.8	
Combination Factor,	Kc	=	0.9	
Design wind pressure Pd		=	Kd x Ka x Kc x Pz	
		=	0.94	KN/Sqm

4.1 General

The problem is defined in previous chapters along with loading conditions prescribed in chapter three. The flow and methodology of the research work related to different cases of various span with respect to different codes for particular loading condition is discussed in the current chapter

4.2 Flow of Research:

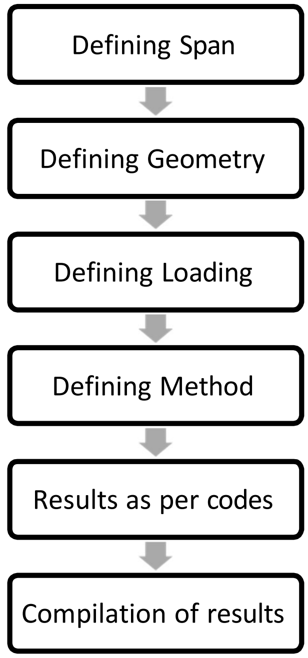


Figure No. 4.1 Flow of Research

4.3 Comparison of various standards:

IS 800-2007:

1. **Material Safety Factors:**

- γm (for materials): The partial safety factor for materials in IS 800-2007 typically ranges from 1.10 to 1.15, depending on the type and quality of material used. This factor accounts for uncertainties in material properties and manufacturing processes.

2. **Load Safety Factors:**

- γf (for loads and load combinations): The partial safety factor for loads and load combinations varies based on the type of load and the design scenario. For example:
- Dead Loads: 1.25 to 1.50
- Live Loads: 1.50 to 2.00
- Wind Loads: 1.50 to 1.75
- Seismic Loads: 1.00 to 1.25 These factors are applied to various load combinations to ensure structural safety under different loading conditions.

EN 1993-1-1:2005:

1. **Material Safety Factors:**

- γM (for materials): Eurocode 3 typically uses a single partial safety factor γM for materials, which ranges from 1.00 to 1.10. This factor accounts for uncertainties in material properties and manufacturing processes, with lower values indicating higher reliability.

2. **Load Safety Factors:**

- γF (for loads and load combinations): Eurocode 3 employs partial safety factors for different types of loads and load combinations. For example:
- Dead Loads: 1.35
- Live Loads: 1.50
- Wind Loads: 1.00 to 1.50 (depending on the design method and region)

Comparison:

1. **Material Safety Factors:**

- IS 800-2007 typically employs higher partial safety factors for materials compared to Eurocode 3. This may indicate a more conservative approach in accounting for uncertainties in material properties and manufacturing processes in the Indian standard.

2. **Load Safety Factors:**

- The partial safety factors for loads and load combinations in IS 800-2007 tend to vary more widely compared to Eurocode 3, reflecting different design philosophies and regional practices.
- While Eurocode 3 generally uses lower partial safety factors for loads and load combinations, IS 800-2007 may have higher factors, especially for live loads and wind loads. This could result in more conservative designs under certain loading conditions.

In summary, while both IS 800-2007 and Eurocode 3 Part 1-1 employ partial safety factors to ensure structural safety, there are differences in the magnitude and application of these factors. IS 800-2007 may have higher partial safety factors for materials and loads compared to Eurocode 3, reflecting different design approaches and regional practices.

4.4 Flow of work:

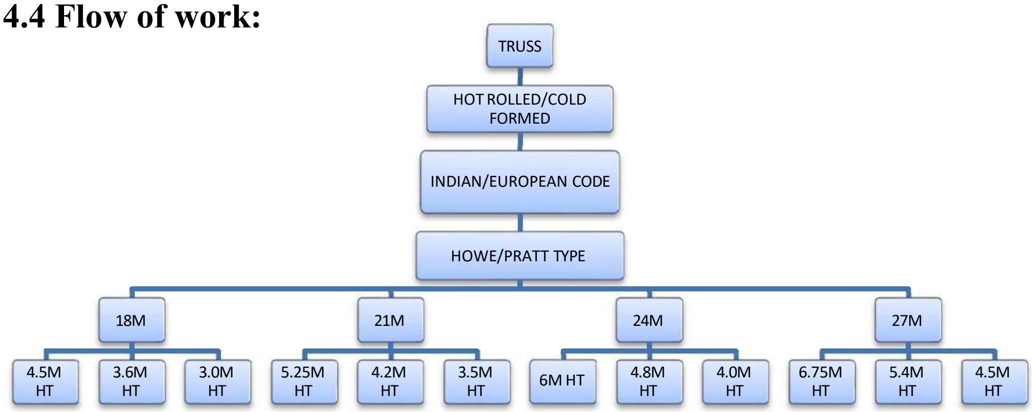


Figure No. 4.2 Cases considered

The above flowchart illustrates the research workflow for designing and comparing steel truss structure, showcasing the steps involved in comparing different design codes, material types, and truss configurations. Below is a detailed explanation of each step in the flowchart:

1. **Truss**:
2. The study began with the general category of the truss, which is a structural framework commonly used in bridges, roofs, and towers.

3. **Hot Rolled/Cold Formed:**

- The next stage involved selecting the type of steel sections:
- **Hot Rolled Steel**: Formed at high temperatures, these sections are typically used for robust and larger structural applications.
- **Cold Formed Steel**: Shaped at room temperature, resulting in lighter and more precise components, suitable for smaller or more intricate designs.
- Both types of materials were analysed to understand their performance, advantages, and limitations.

4. **Indian/European Code:**

- Design codes were then applied, with both Indian and European codes being used for comparative analysis. This helped to identify the differences and similarities in structural design practices, standards, and safety measures between the two codes.

5. **Howe/Pratt Type:**

- Two common types of trusses were examined:
- **Howe Truss:** Characterized by diagonal members that slope towards the centre, commonly used in bridge applications.
- **Pratt Truss:** Features diagonal members that slope towards the supports, widely used in both bridges and building roofs.
- These truss types were evaluated under both codes and material types to assess their structural efficiency and applicability.

6. **Span Lengths:**

- Trusses with different span lengths are designed to cover a range of heights (Span/6, Span/5 and Span/4):
- **18M Span:** Evaluated at heights of 4.5M, 3.6M, and 3.0M.
- **21M Span:** Evaluated at heights of 5.25M, 4.2M, and 3.5M.
- **24M Span:** Evaluated at heights of 6M, 4.8M, and 4.0M.
- **27M Span:** Evaluated at heights of 6.75M, 5.4M, and 4.5M.

4.5 Summary

The above flowchart illustrated the comprehensive research workflow for designing truss structures, detailing the steps involved in comparing different design codes, material types, and truss configurations carried out in this research work. In the forthcoming chapter, the findings from this research workflow have been presented and analyzed. This includes a comparative analysis of the performance metrics of trusses designed using Indian versus European codes, highlighting the structural advantages and limitations of hot rolled versus cold formed steel sections. Additionally, the effectiveness and efficiency of Howe and Pratt trusses in different structural applications have been evaluated. Insights into the optimal span lengths and heights for various design requirements have also been discussed.

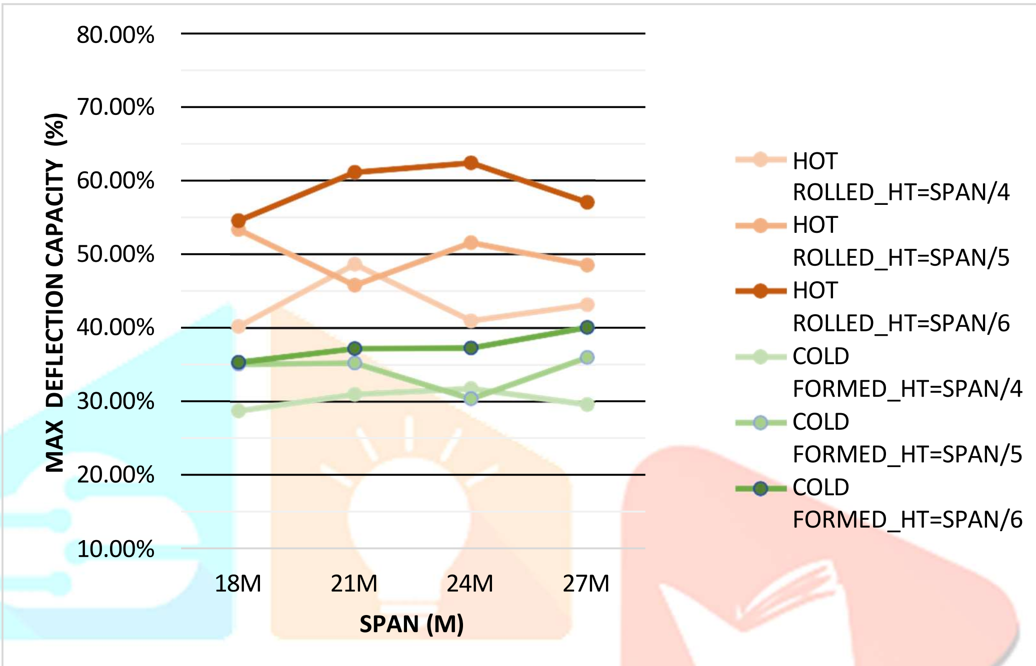
5.1 General

The current project work is a comparative study of Hot Rolled and Cold Formed Trusses having different spans with respect to different codes as per flow of project mentioned in the previous chapter. Trusses with varying span and height with respect to different codes are designed governed by various parameters calculated using tables. The result value of various parameters with different codes are solved using finite element package. Maximum and minimum of the forces and maximum punching ratio are obtained for each case, the non-dimensional variations are plotted and discussed in the current chapter.

5.1 Comparison of Codal Provisions on Hot Rolled and Cold Formed Trusses:

5.1.1 Deflection

5.1.1.1 Indian Code Howe Truss



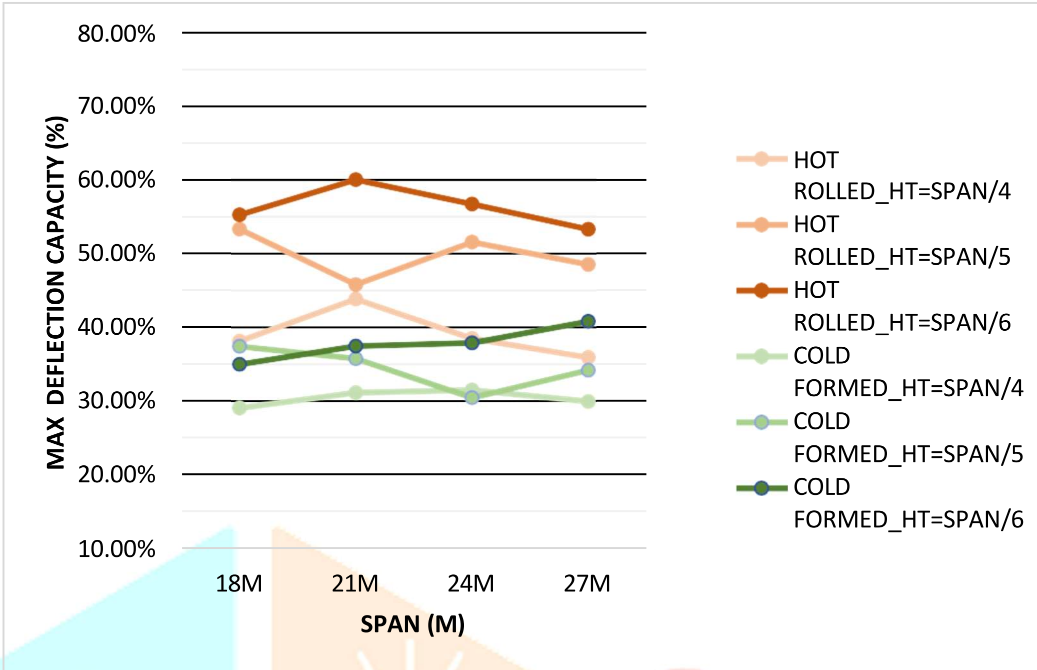
G17- Variation of maximum deflection capacity against span for Howe Trusses for various heights as per Indian Code

Observations:

From the above graphs following points are noted.

1. The deflection capacities are consistently lower for Cold Formed trusses compared to Hot Rolled trusses in all cases.
2. Deflection values increase with increase in truss span for Cold Formed as well as Hot Rolled Trusses.
3. Cold Formed trusses give lowest values of deflection compared to Hot Rolled trusses of deflection for all heights considered.
4. The results of deflection capacities for Hot Rolled trusses are almost 25% more than Cold Formed trusses.

5.1.1.2 Indian Code Pratt Truss



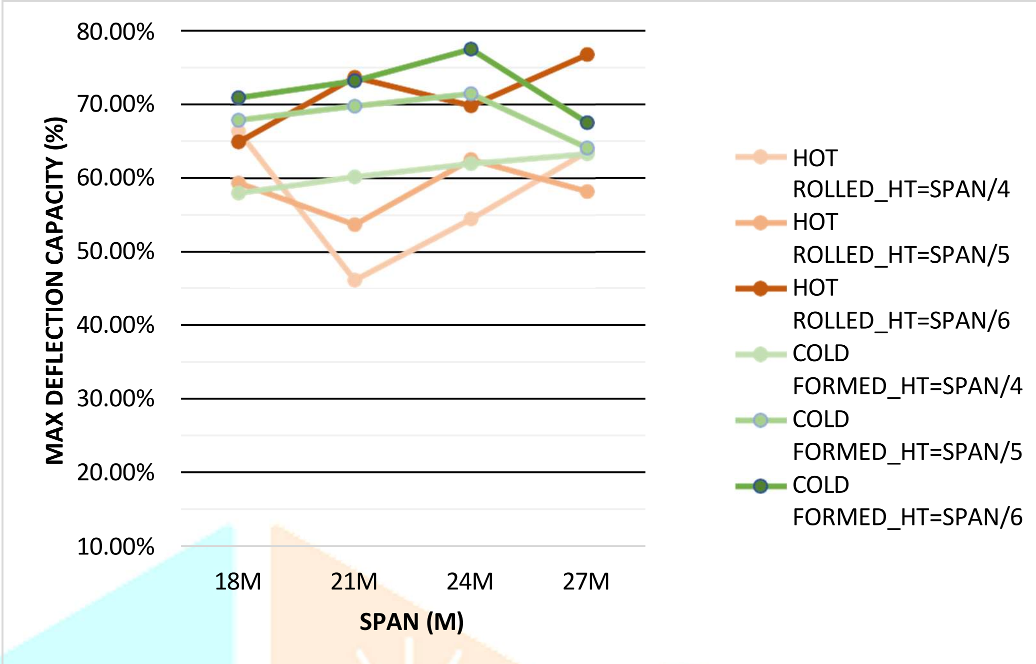
G18- Variation of maximum deflection capacity against span for Pratt Trusses for various heights as per Indian Code

<u>Observations:</u>

From the above graphs following points are noted.

1. The deflection capacities are consistently lower for Cold Formed trusses compared to Hot Rolled trusses in almost all cases.
2. Deflection values increase with increase in truss span for Cold Formed as well as Hot Rolled Trusses.
3. Cold Formed trusses give lowest values of deflection compared to Hot Rolled trusses of deflection for all heights considered.
4. The results of deflection capacities for Hot Rolled trusses are almost 23% more than Cold Formed trusses.

5.1.1.3 European Code Howe Truss



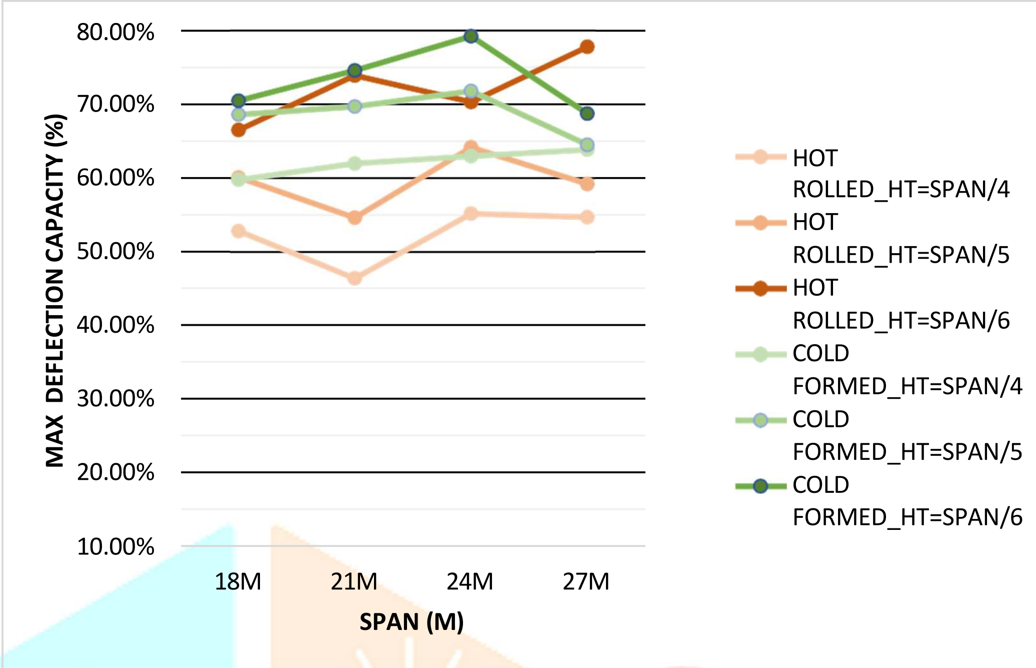
G19- Variation of maximum deflection capacity against span for Howe Trusses for various heights as per European Code

Observations:

From the above graphs following points are noted.

1. The deflection capacities are consistently lower for Hot Rolled trusses compared to Cold Formed trusses in almost all cases.
2. Deflection values increase with increase in truss span for Cold Formed as well as Hot Rolled Trusses.
3. Cold Formed trusses give almost same values of deflection compared to Hot Rolled trusses of deflection for all heights considered.
4. The variation in deflection capacities for Hot Rolled and Cold Formed trusses are almost 16%.

5.1.1.4 European Code Pratt Truss



G20- Variation of maximum deflection capacity against span for Pratt Trusses for various heights as per European Code

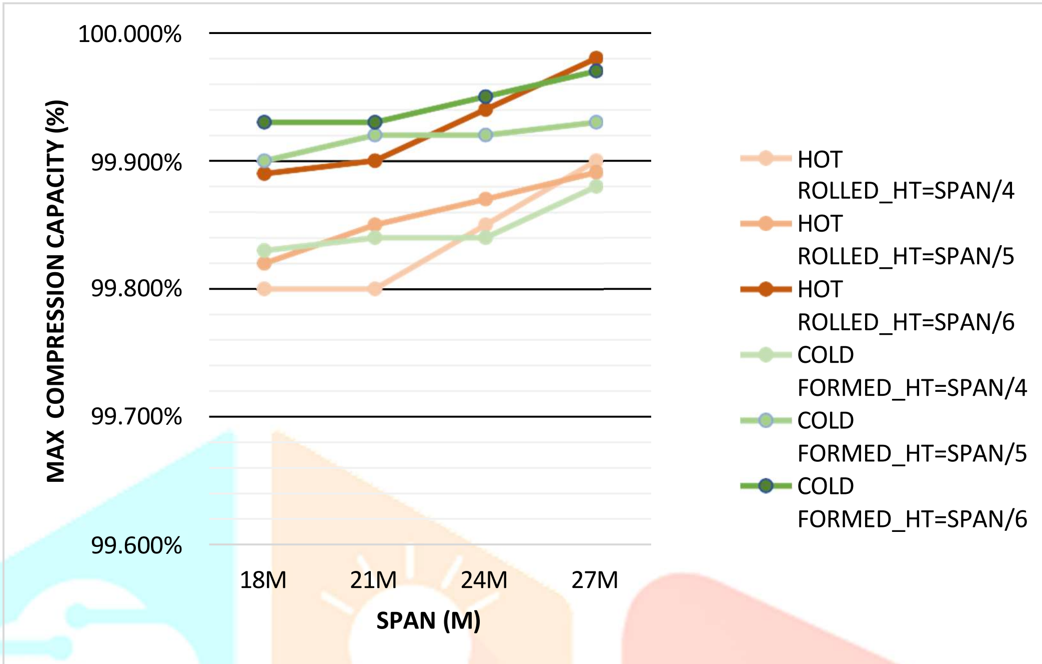
Observations:

From the above graphs following points are noted.

1. The deflection capacities are consistently lower for Hot Rolled trusses compared to Cold Formed trusses in almost all cases.
2. Deflection values increase with increase in truss span for Cold Formed as well as Hot Rolled Trusses.
3. Cold Formed trusses give almost same values of deflection compared to Hot Rolled trusses of deflection for all heights considered.
4. The variation in deflection capacities for Hot Rolled and Cold Formed trusses are almost 16%.

5.1.2 Compression

5.1.2.1 Indian Code Howe Truss



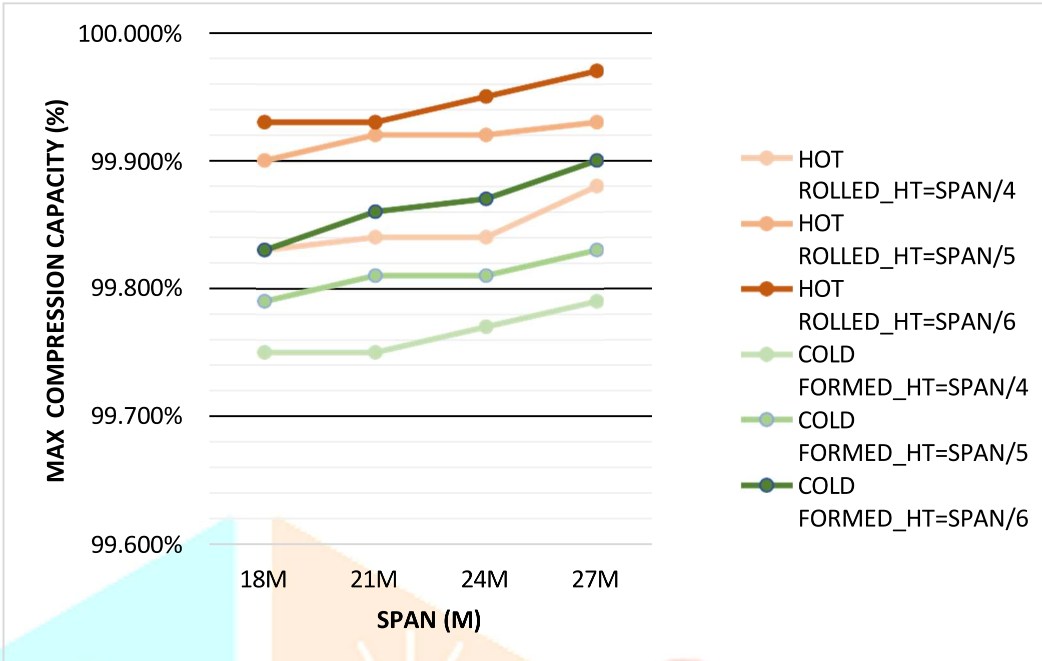
G21- Variation of maximum compression capacity against span for Howe Trusses for various heights as per European Code

Observations:

From the above graphs following points are noted.

1. The compression capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Compression values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives lowest values of compression as compared to Hot Rolled trusses for all cases of height considered.
4. The results of compression values for Hot Rolled trusses are almost 27% more than Cold Formed trusses.

5.1.2.2 Indian Code Pratt Truss



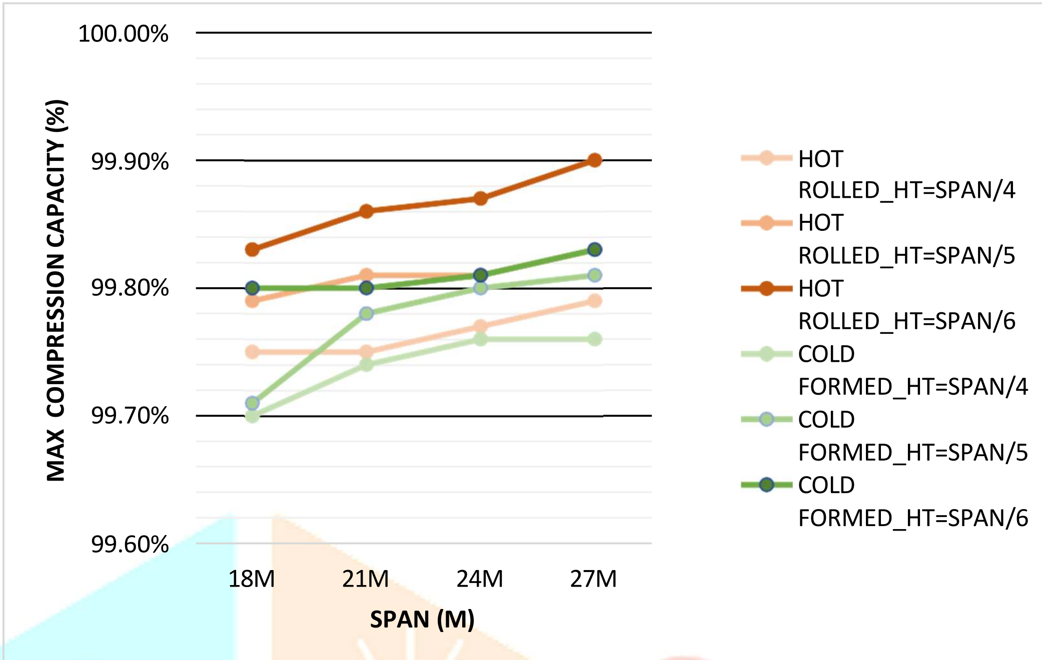
G22- Variation of maximum compression capacity against span for Pratt Trusses for various heights as per European Code

<u>Observations:</u>

From the above graphs following points are noted.

1. The compression capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Compression values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives lowest values of compression as compared to Hot Rolled trusses for all cases of height considered.
4. The results of compression values for Hot Rolled trusses are almost 29% more than Cold Formed trusses.

5.1.2.3 European Code Howe Truss



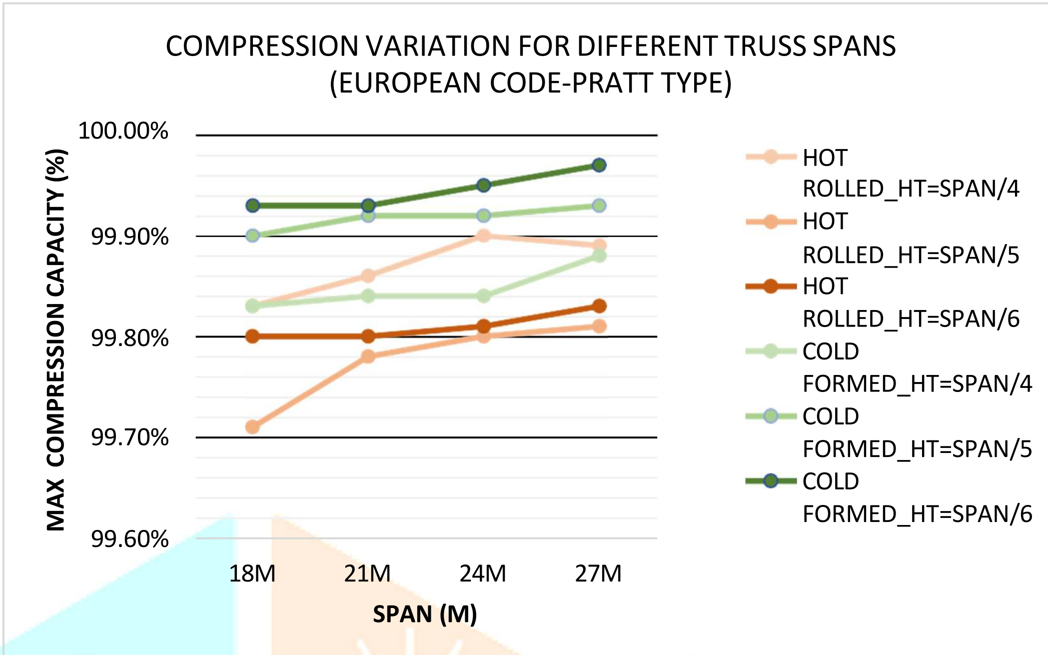
G23- Variation of maximum compression capacity against span for Howe Trusses for various heights as per European Code

Observations:

From the above graphs following points are noted.

1. The compression capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Compression values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives almost same values of compression as compared to Hot Rolled trusses for all cases of height considered.
4. The variation of compression values for Hot Rolled and Cold Formed trusses are negligible.

5.1.2.4 European Code Pratt Truss



G24- Variation of maximum compression capacity against span for Pratt Trusses for various heights as per European Code

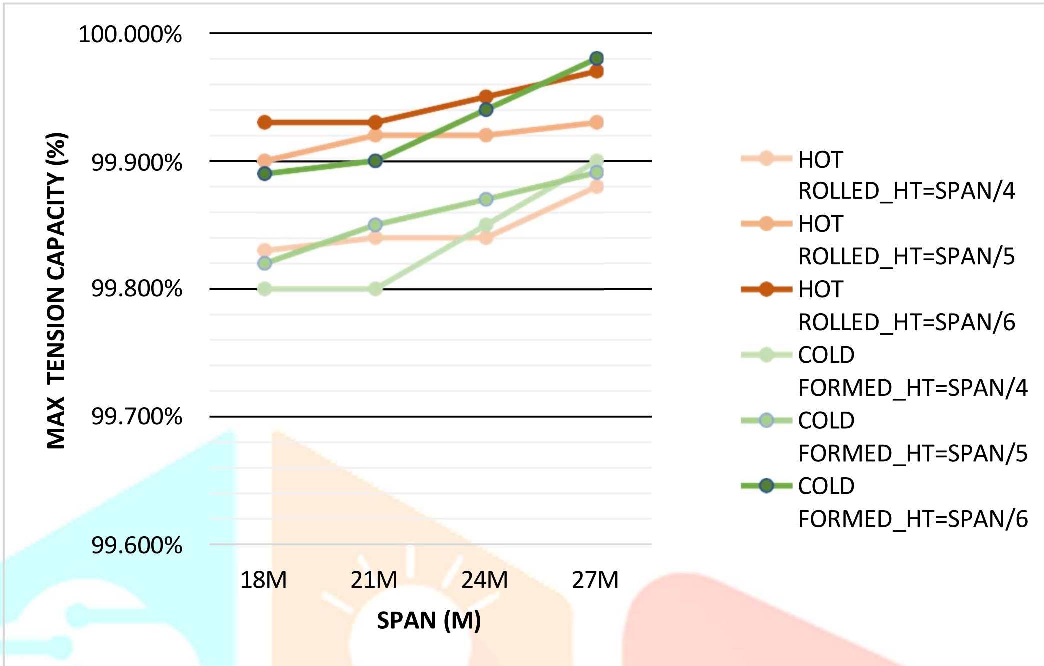
Observations:

From the above graphs following points are noted.

1. The compression capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Compression values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives almost same values of compression as compared to Hot Rolled trusses for all cases of height considered.
4. The variation of compression values for Hot Rolled and Cold Formed trusses are negligible.

5.1.3 Tension

5.1.3.1 Indian Code Howe Truss



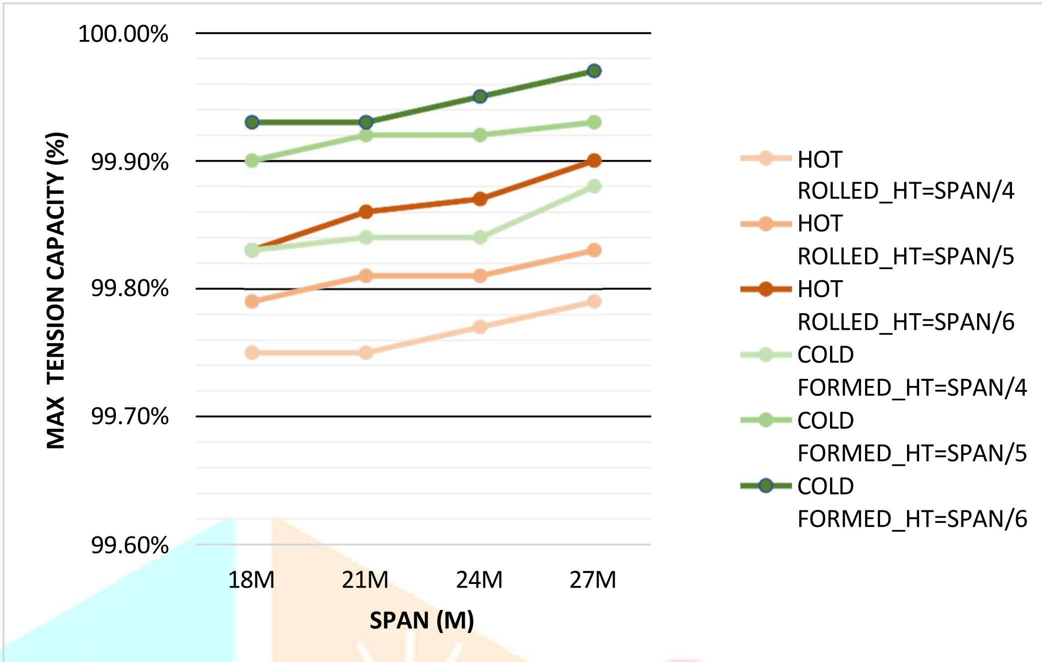
G25- Variation of maximum tension capacity against span for Howe Trusses for various heights as per Indian Code

Observations:

From the above graphs following points are noted.

1. The tension capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Tension values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives lowest values of Tension as compared to Hot Rolled trusses for all cases of height considered.
4. The results of compression values for Hot Rolled trusses are almost 27% more than Cold Formed trusses.

5.1.3.2 Indian Code Pratt Truss



G26- Variation of maximum tension capacity against span for Pratt Trusses for various heights as per Indian Code

Observations:

From the above graphs following points are noted.

1. The tension capacities are almost same for Hot Rolled and Cold Formed trusses in all cases.
2. Tension values increase with increase in truss span for Hot Rolled and Cold Formed trusses for all heights considered.
3. The Cold Formed trusses gives lowest values of Tension as compared to Hot Rolled trusses for all cases of height considered.
4. The results of compression values for Hot Rolled trusses are almost 29% more than Cold Formed trusses.

6.1 General

Results from the previous chapter are evaluated and the resulting conclusions derived from investigations are summarized below.

6.2 Weight:

1) Weight of Hot Rolled Howe & Pratt trusses as per Indian code vary in the range of 21 Tons to 37 Tons
2) Weight of Hot Rolled Howe & Pratt trusses as per European code vary in the range of 10 Tons to 23 Tons
3) Weight of Cold Formed Howe & Pratt trusses as per Indian code vary in the range of 15 Tons to 34 Tons
4) Weight of Cold Formed Howe & Pratt trusses as per European code vary in the range of 11 Tons to 24 Tons

Comparison

1) Howe & Pratt Trusses give almost same values of weight for Individual Codes for all heights considered. Also, for both Howe and Pratt trusses weight increases with increase in span.
2) Weight of Hot Rolled Trusses are higher than Cold Formed trusses by about 6 Tons as per Indian code whereas the variation is negligible as per European Code
3) Hot Rolled trusses designed as per Indian code give higher weight compared to European code by about 14 Tons
4) Cold Formed trusses designed as per Indian code give higher weight compared to European code by about 10 Tons

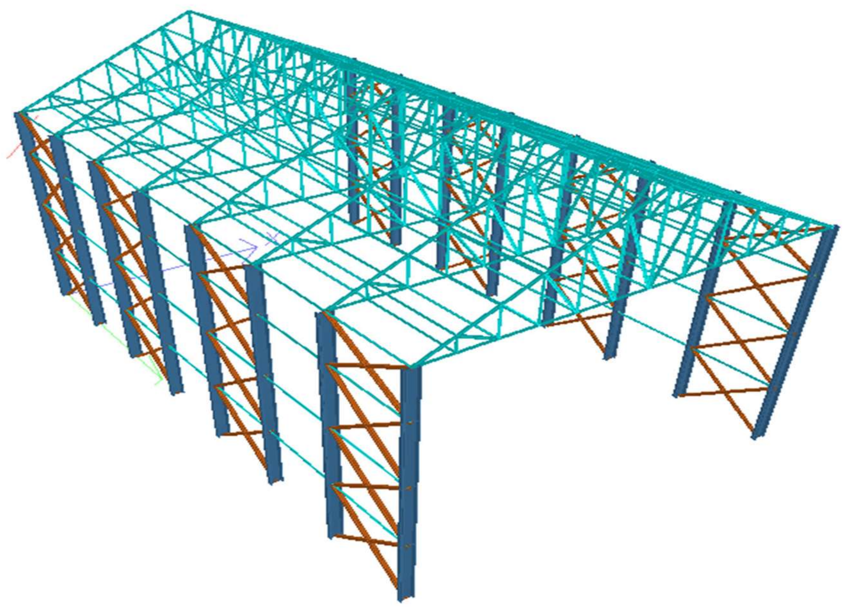


Figure no. B-1 Typical Truss model for Howe Trusses.

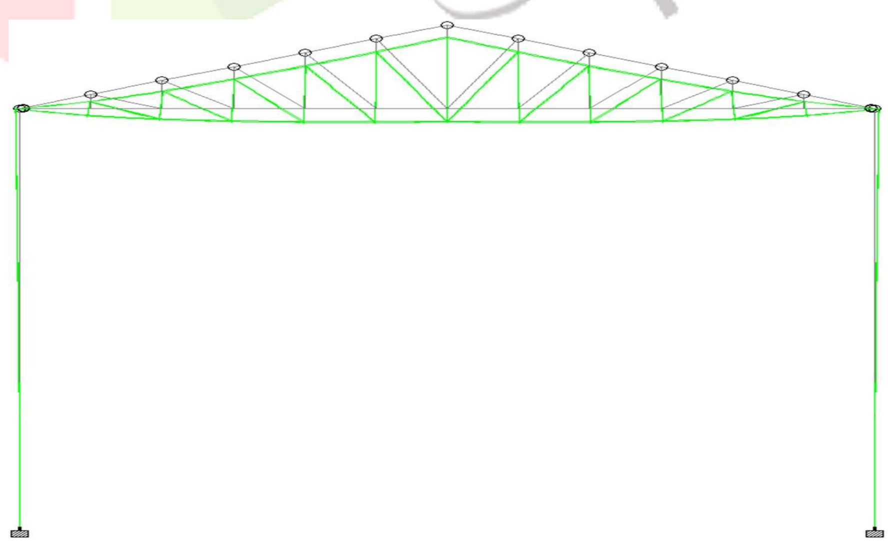


Figure no. B-2 Typical Deflection diagram for Howe Trusses

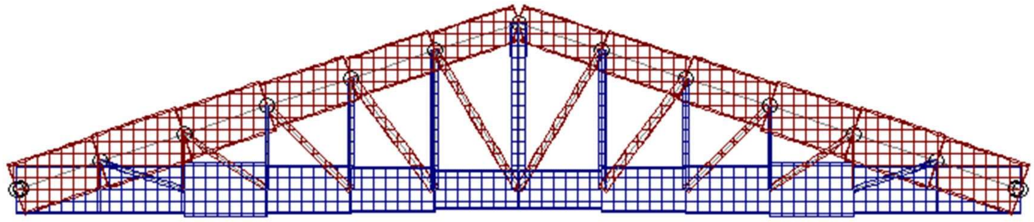


Figure no. B-3 Typical Compression &Tension diagram for Howe Trusses

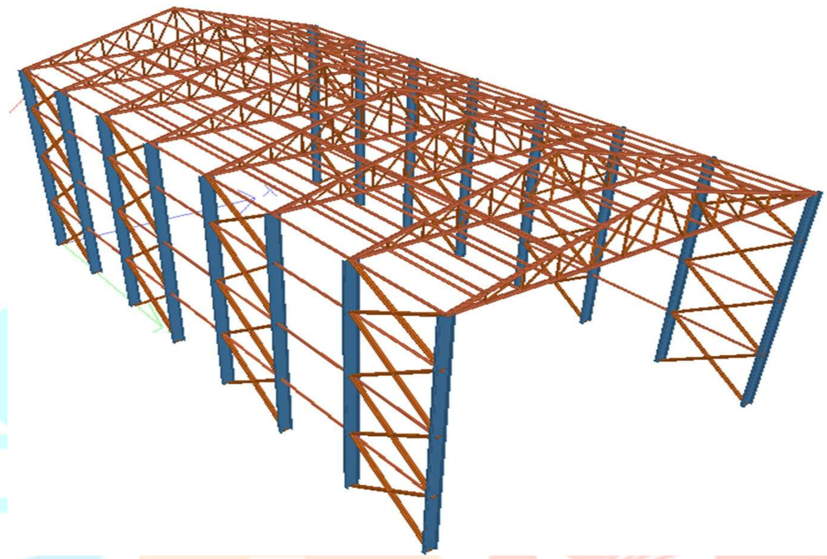


Figure no. B-4 Typical Truss model for Pratt Trusses.

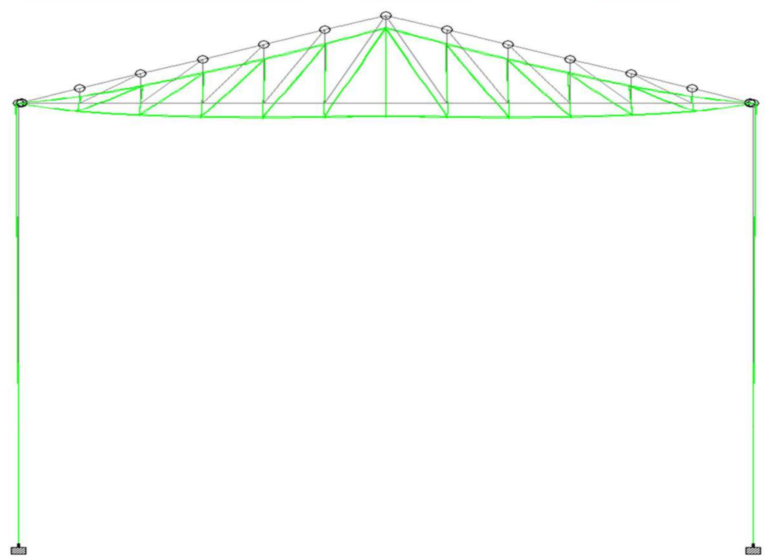


Figure no. B-2 Typical Deflection diagram for Pratt Trusses

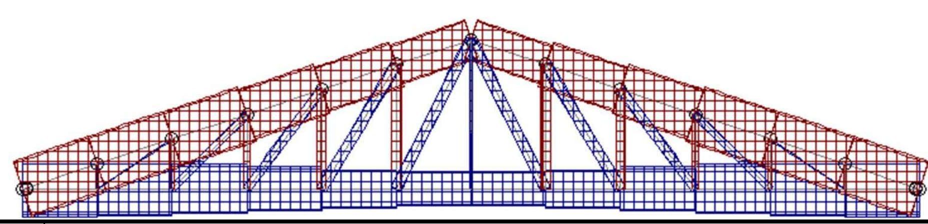


Figure no. B-6 Typical Compression &Tension diagram for Pratt Trusses

Bibliography

REFERENCES:

1) Ain Shams, (2013) "Resistance of cold-formed steel sections to combined bending and web crippling" Engineering Journal

2) Gianmaria Di Lorenzo and Raffaele Landolfo, (2002), "Study of Innovative Built-Up Cold- Formed Beams", International Speciality conference of cold formed section

3) K.Jothi Baskar and R.Aravindh, (2016),"Experimental Study on Behavior of Cold Formed Steel using C Channel Section under Axial Compression", International Journal for Innovative Research in Science & Technology

4) Mahdi Bitarafan, Youssef Hossain zadeh, Saman Yaghmayi, (2013), "Evaluating the connecting members of cold formed steel structures in reconstruction of earthquake-prone areas in Iran using AHP methods" Alexandria Engineering Journal (ELSEVIER)

5) Mohd Syahrul Hisyam Mohd Sani, (2016), Experimental Study on Flexural Behavior of Cold formed Steel Channels with Curved Section ARPN Journal of Engineering and Applied Science

6) Pooja S.Ajay, J.Samuel, Dr. P.S Joanna, (2014), "study of Flexural behaviour of cold formed steel beams with Diagonal stiffener", International Journal of Engineering Trends and Technology

7) S.P.Keerthana, K.Jothibaskar, (2016), 'Experimental Study on Behavior of Cold Formed Steel Using Built-Up Section under Axial Compression' IRACST – Engineering Science and Technology: An International Journal

8) Supriya Khedkar, Shilpa Kewate (2015), "Comparative study of hot rolled and cold formed transmission line tower", International Journal of Emerging Technology and Advanced Engineering.

9) Salokhe S. A, Patil P. S, (2015), "Comparative study of cold formed steel and hot rolled steel section under compressive loading" International Journal of Research Engineering and Technology,

10) V.Jaya sheela , R.Vijayasarathy (2015), "Experimental Study on Behavior of Stiffened Cold Formed Steel Built Up Hat Section under Flexure by Varying the Depth by Finite Element Analysis", International Journal of Engineering Trends and Technology