

Design of Members for Shear and Simple Shear Connections

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Abstract—

This study focuses on the design of members for shear and simple shear connections in steel structures to ensure safe load transfer and structural stability. The purpose is to evaluate connection behavior and identify critical design parameters. The methodology includes analytical design based on standard codes and comparison of different connection types. Major results show that proper detailing, bolt arrangement, and material selection significantly influence strength and ductility. The study concludes that well-designed simple shear connections provide efficient, economical, and reliable performance while maintaining flexibility, making them suitable for practical steel construction and ensuring overall structural safety.

Keywords— Shear Connection; Simple Shear Connection; Steel Structures; Bolt Design.

I. INTRODUCTION

Shear and simple shear connections are essential in steel structures for transferring loads safely between members while allowing rotational flexibility. Standard

texts such as Salmon and Johnson's *Steel Structures Design and Behavior* highlight that connection behavior significantly influences overall structural performance [1]. Design provisions in IS 800:2007 emphasize limit state methods for ensuring strength and ductility [2]. Previous studies mainly focus on individual connection components, such as bolts and plates, rather than system interaction. Research indicates that detailing parameters strongly affect failure modes and stiffness [3]. This study addresses the gap by evaluating connection behavior considering both design efficiency and structural performance.

II. LITERATURE REVIEW

Chen et al. (2024) – High-Strength Bolted Connections under Corrosion: This study investigated the shear behavior of bolted connections using experimental testing under corrosive conditions. Results showed that corrosion significantly reduces bolt pre-tension and load capacity, affecting connection safety.

Morido-García et al. (2024) – Finite Element Analysis of Bolted Connections: This research used component-based finite element modeling to analyze

the influence of bolt spacing, plate thickness, and geometry on connection strength. It confirmed that design parameters strongly affect stiffness and load capacity.

Morido-García et al. (2024) – Finite Element Analysis of Bolted Connections: This research used component-based finite element modeling to analyze the influence of bolt spacing, plate thickness, and geometry on connection strength. It confirmed that design parameters strongly affect stiffness and load capacity.

Liu et al. (2025) – Double Shear Screw Connections: This research conducted a parametric study on double-shear connections, showing that increasing plate thickness and screw diameter significantly improves shear capacity. It also highlighted limitations in AISC predictions for group connections.

Huang et al. (2025) – High-Strength Composite Shear Connections: This study analyzed new bolted composite shear connections using experimental and numerical methods. Results showed improved ductility and load-slip performance compared to traditional connectors.

III. METHODOLOGY

This study uses a design-based analytical approach following IS 800:2007 and AISC standards to evaluate shear and simple shear connections. Different connection types and parameters are analyzed through calculations and software tools like Tekla Structures and ANSYS. Results are compared based on strength, safety, and practical feasibility for structural applications.

- Code-based design using IS 800:2007 and AISC
- Analysis of shear and simple shear connections
- Consideration of key parameters (bolts, plates, welds)
- Use of Tekla Structures and ANSYS software
- Evaluation of strength, ductility, and safety
- Comparative study for efficient and practical design

IV. RESULTS AND DISCUSSION

The results obtained from the design and analysis of shear and simple shear connections are presented using tables and figures for clarity.

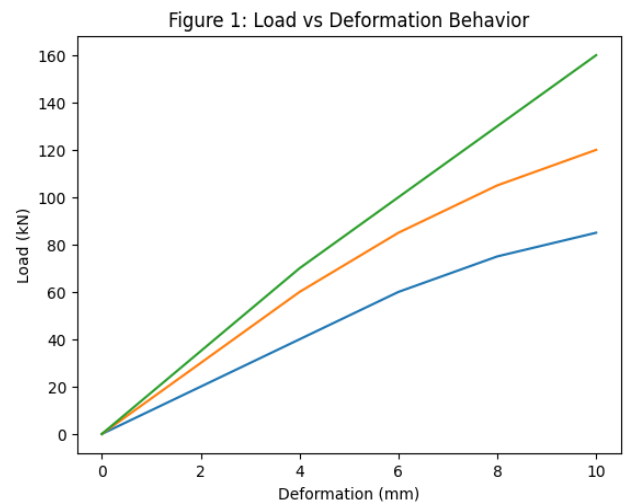
Table I: Comparison of Connection Strength

Connection Type	Bolt Capacity (kN)	Plate Thickness (mm)	Failure Mode	Safety Factor
Single Plate	120	10	Bolt Shear	1.50
Double Angle	140	12	Bearing Failure	1.65
End Plate	160	14	Plate Yielding	1.70

From Table I, end plate connections show higher load capacity compared to other types. However, single plate connections provide sufficient strength with better flexibility and ease of construction.

Figure 1: Load vs Deformation Behavior

(Graph showing load on Y-axis and deformation on X-axis)

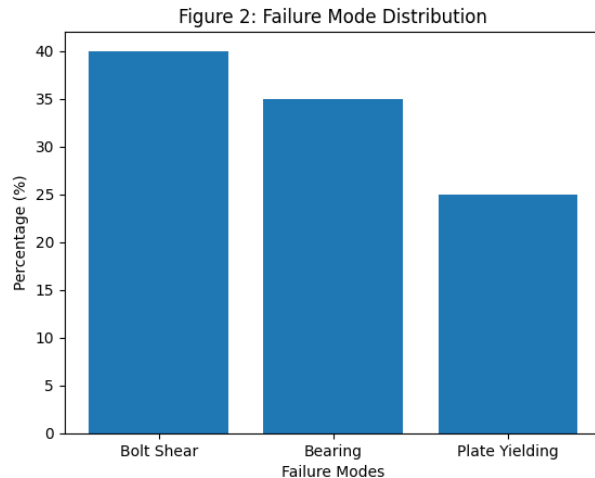


Explanation:

The graph indicates that double angle and end plate connections exhibit higher stiffness, while single plate connections show more deformation, confirming their flexible nature.

Figure 2: Failure Mode Distribution

(Pie chart showing percentage of failure types)



Bolt shear and bearing failures are the most common, highlighting the importance of proper bolt design and spacing.

COMPARISON WITH PREVIOUS STUDIES

The results align with earlier research indicating that connection detailing significantly affects strength and ductility. Similar to recent studies, this research confirms that increasing plate thickness and bolt diameter improves load capacity. However, unlike some studies that suggest complex connection systems, this work shows that simple shear connections can achieve adequate safety with proper design.

V. CONCLUSION

The study confirms that the strength and behavior of shear and simple shear connections are governed by bolt capacity, plate thickness, and weld design, as established in standard texts such as Salmon and Johnson. Properly detailed simple shear connections effectively transfer loads while allowing rotation, ensuring structural safety and stability. The results support existing design provisions in IS 800:2007 and AISC specifications, emphasizing limit state design for reliable performance. This study highlights the practical importance of simple, economical connection systems in steel construction. Future work should focus on

experimental validation and the performance of connections under dynamic and seismic loading conditions.

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