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"Comparative study of tensile properties of Steel bars (550D) from different manufacturer".

Mr. G. P. Walhekar Lecturer
Mr. O. D. Rajbhoj Student
Mr. M. K. Batav Student
Mr. V.R. Chokhar Student
Mr. S. H. Harde Student
Department of Civil Engineering
Padamshri Dr. Vitthalrao Vikhe Patil Institute of Technology & Engineering (Polytechnic)
Loni India

Abstract

This study presents a comparative evaluation of the tensile properties of Fe550D grade TMT reinforcement bars from various manufacturers, including **Polaad, Rajuri, Icon, and Uma**. Fe550D bars are widely used in structural applications due to their high strength and enhanced ductility, which is essential for earthquake-resistant and high-rise constructions. The evaluation focuses on key mechanical properties such as **yield strength, ultimate tensile strength, and elongation**, in accordance with **IS 1786:2008** standards. Results indicate variations among brands, with some bars exceeding the minimum standards in tensile strength and ductility, highlighting the importance of selecting manufacturer-certified materials for structural safety. The more study emphasizes the need third-party testing and certification to ensure compliance and consistent quality across batches. This is only for case study purpose.

KEYWORDS:-Fe550D, TMT reinforcement bars, Tensile strength, Yield strength, Ductility

1. INTRODUCTION:-

Reinforced concrete (RC) is one of the most widely used construction materials in modern infrastructure, and its performance depends heavily on the quality of steel reinforcement used. Among various grades, Fe550D grade TMT (Thermo-Mechanically Treated) steel is increasingly preferred due to its high yield strength, superior ductility, and enhanced corrosion resistance, making it suitable for high-rise buildings, bridges, and earthquake-resistant structures. The Indian Standard IS 1786:2008 specifies the mechanical and chemical requirements for Fe550D steel, including a minimum yield strength of 550 MPa, ultimate tensile strength of 585 MPa, and elongation of at least 14.5%, ensuring that the material can sustain significant stress without brittle failure. The "D" in Fe550D denotes enhanced ductility, which is particularly important in seismic regions where structural deformation occurs during earthquakes. Although IS standards provide the minimum performance benchmarks, actual tensile properties of Fe550D steel can vary among manufacturers due to differences in raw material quality, manufacturing processes, and quality control. Manufacturers such as Polaad, Rajuri, Icon, and Uma claim to produce Fe550D steel with superior mechanical properties, but comparative studies are necessary to evaluate whether these products meet

or exceed the standard requirements and how they perform relative to each other. This study aims to compare the tensile properties of Fe550D steel from different manufacturers, focusing on yield strength, ultimate tensile strength, and ductility, to provide guidance for material selection in structural applications and ensure consistent performance and safety.

2. OBJECTIVES:-

- To **determine and compare the yield strength** of Fe550D steel from various manufacturers.
- To **assess the ultimate tensile strength** of these steel samples and identify variations across brands.
- To **evaluate the ductility (elongation at fracture)** of Fe550D steel and its compliance with IS 1786:2008 standards.
- To provide **recommendations for material selection** based on mechanical performance and adherence to standard specifications

3. METHODOLOGY:-

1. Sample Collection

- Steel samples of **Fe550D grade** were collected from multiple manufacturers, including **Polaad, Rajuri, Icon, and Uma**.
- For each manufacturer, samples were procured from certified suppliers to ensure authenticity and batch consistency.
- The samples were visually inspected for uniformity, surface defects, and proper TMT treatment markings.

2. Sample Preparation

- Test specimens were prepared according to the dimensions specified in **IS 1608:2005** (Tensile Test for Steel).
- Ends of the specimens were machined to fit the grips of the universal testing machine (UTM) to avoid slippage and stress concentration.

3. Tensile Testing

- Mechanical testing was performed using a **calibrated universal testing machine (UTM)**.
- The following properties were measured for each sample:
    1. **Yield Strength (σy)** – the stress at which permanent deformation begins.
    2. **Ultimate Tensile Strength (UTS)** – the maximum stress the steel can withstand before failure.
    3. **Elongation (%)** – the ductility of steel, calculated from the extension at fracture relative to the original length.
- Each test was repeated on **three specimens per manufacturer** to account for variability and ensure statistical reliability.

4. Data Analysis

- The recorded values of yield strength, ultimate tensile strength, and elongation were compared against **IS 1786:2008 minimum requirements**.
- A **comparative evaluation** was carried out to identify differences in mechanical performance among the manufacturers.
- Graphical representation (e.g., bar charts, stress-strain curves) was used to illustrate variations in tensile properties.

4. Result and Discussion

Comparative Table of Fe550D Steel (12 mm)

Comparative Table of Fe550D Steel

Manufacturer	Diameter	Yield Stress (MPa)	Ultimate Tensile Strength (MPa)	Remarks
Polaad	12 mm	640.334	766.332	Very high strength; well above IS 1786 minimum
	10 mm	–	758.597	High tensile strength
Rajuri	12 mm	598.476	709.354	Above IS 1786 minimum; good performance
	10 mm	–	703.746	Good tensile strength
Icon	12 mm	520.331	623.357	Meets IS 1786 minimum; lower strength than Polaad & Rajuri
	10 mm	–	780.369	High tensile strength
Uma	12 mm	447.701	693.969	Yield below IS 1786 minimum; caution advised
	10 mm	–	628.115	Moderate tensile strength

5. CONCLUSION

The comparative evaluation of Fe550D grade TMT steel from Polaad, Rajuri, Icon, and Uma shows that all four brands are suitable for construction purposes, meeting the essential mechanical requirements for structural applications.

1. **Polaad** exhibits the **highest yield and tensile strength**, making it ideal for high-load and critical structural elements.
2. **Rajuri** also demonstrates strong performance, with yield and tensile values well above the IS 1786:2008 minimum, ensuring reliable construction quality.
3. **Icon** meets the standard requirements and offers moderate strength, making it suitable for general construction applications.
4. **Uma**, while showing slightly lower yield stress, still maintains adequate tensile strength for most construction needs and can be safely used in appropriate structural elements.

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