



A TECHNICAL REPORT ON TENSILE TESTING OF TMT BARS

Report No. NITT/MECH/SOM/2024-2025/R012

DATE: 10.02.2025

ISSUED To:

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Naidupet,
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1. BACKGROUND

An email received from Mr. Navaneethan /AWM dated 27.12.2024 with seven different diameters of TMT bars (Fe550-D Grade) for finding out the mechanical properties through tensile test, bend test, nominal weight, chemical composition and mean projected area of Ribs as per IS 1786:2008 standard.

2. VISUAL EXAMINATION

The samples received were sound, clean and free from surface defects. Also, samples were straight and does not have any irregularities (refer Figure 1).

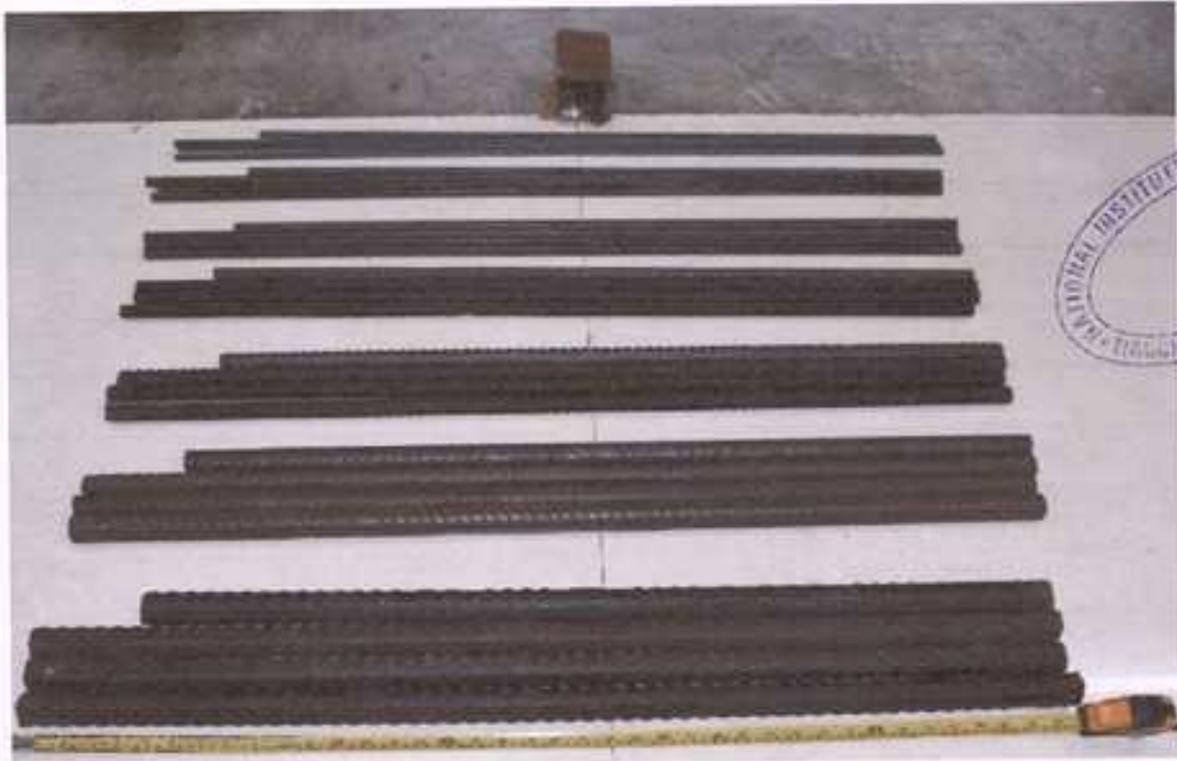


Figure 1. TMT bars – as received condition

**Table 1. TMT bars received with respective dimensions**

Sl. NO.	Diameters of TMT bars	Tensile test of Length 1 m	Bend test of Length 0.9 m	Chemical analysis of length 100 mm
1.	Ø 32 mm.	3 nos.	1 no	1 no
2.	Ø 25 mm.	3 nos.	1 no	1 no
3.	Ø 20 mm.	3 nos.	1 no	1 no
4.	Ø 16 mm.	3 nos.	1 no	1 no
5.	Ø 12 mm.	3 nos.	1 no	1 no
6.	Ø 10 mm.	3 nos.	1 no	1 no
7.	Ø 8 mm.	3 nos.	1 no	1 no

3. TENSILE TEST

The tensile tests were conducted on the TMT rods to find out the mechanical properties (Ultimate tensile strength - UTS, Yield strength - YS and percentage of elongation - PE) as per IS 1608 (Part 1): 2018 recommended in IS 1786: 2008 standard. The gauge length is defined and marked on the material as per the standard recommendation. The results (average values of three samples tested under each category) of the tension test are tabulated in the Table. 2. A sample load vs. displacement curve is shown in Figure 2. Figure 3 shows the samples fractured during the tensile test.

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Table 2. Tensile test results of TMT bars

Sl. No.	Specimen ID	Unit weight (kg/m)	YS, N/mm ²	UTS, N/mm ²	% Of Elongation (%)	Total Elongation (%)	TS/YS Ratio	Fractured Location
1	Ø 8mm	0.392	634.3	717.8	23.31	12.25	1.133	Fractured at gauge location
2	Ø 10mm	0.580	620.8	725.1	20.82	7.91	1.17	
3	Ø 12mm	0.852	596.7	691.9	21.89	8.26	1.16	
4	Ø 16mm	1.524	643.6	747.4	20.24	10.91	1.16	
5	Ø 20mm	2.427	612.4	704.9	19.01	9.41	1.15	
6	Ø 25mm	3.841	638.9	742.9	20.16	8.93	1.16	
7	Ø 32mm	6.323	592.7	712.1	20.21	9.66	1.21	
As per standard IS 1786:2008			Min. 550 N/mm ²	Min. 600 N/mm ²	Min. 14.5%	Min. 5%	Min. 1.08	

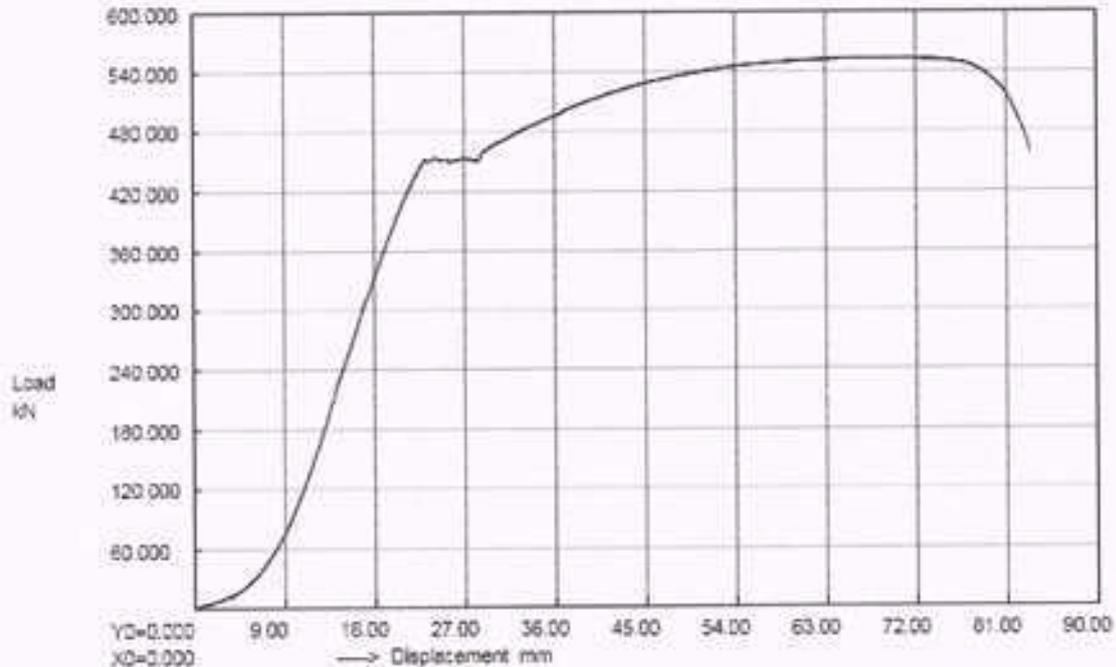


Figure 2. Load vs. Displacement curve for Ø 32mm TMT bar

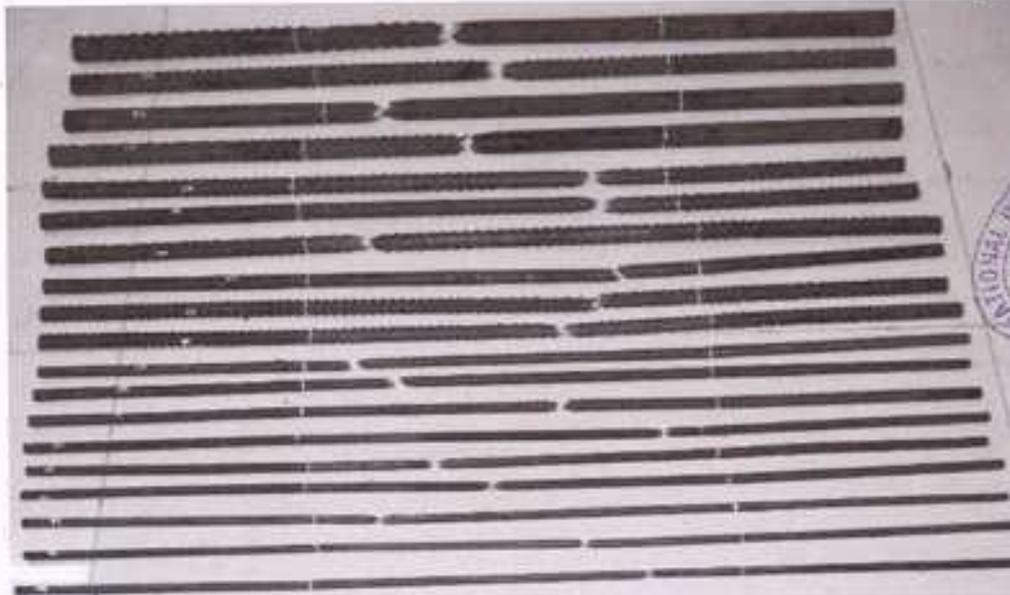


Figure 3. Fractured samples after tensile test

4. BEND TEST

The bend tests were conducted on the TMT bars to find out the ductility of the steel items as per IS 1599: 2019 recommended in IS 1786: 2008 standard. A sample load vs. displacement curve on bent sample is shown in Figure 4 for reference. The



samples after testing are represented in Figure 5. The bent samples did not show any obvious cracks on the surface of the tension and compression layers. The results of the bend test are presented in Table. 3.

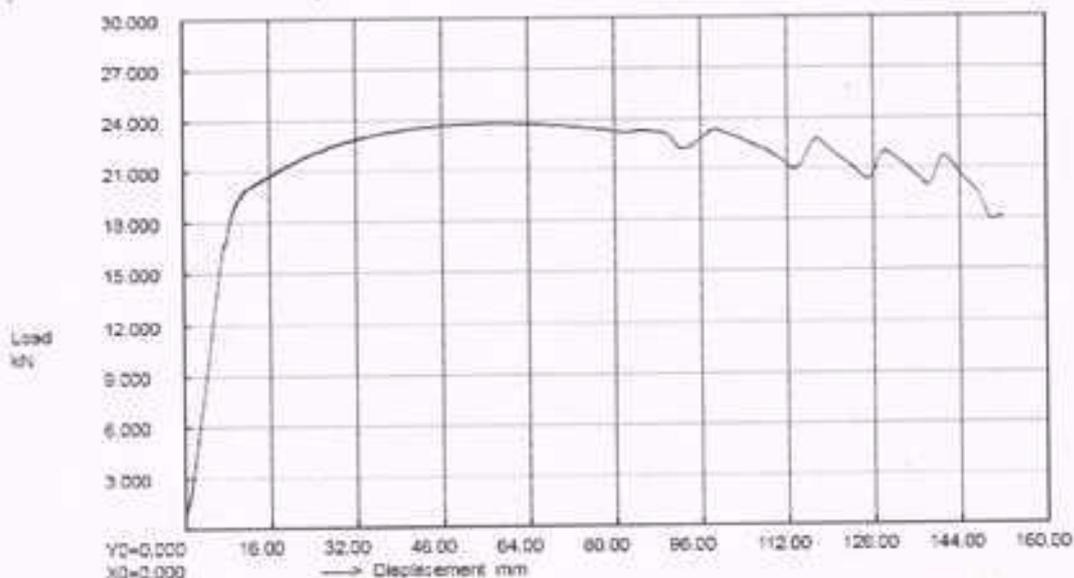


Figure 4. Load vs. displacement curve for Ø 25mm TMT bar

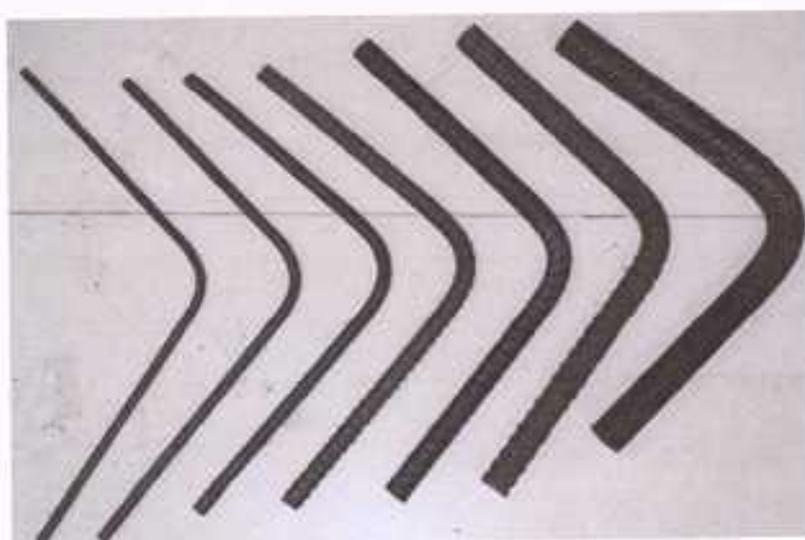


Figure 5. Bend test samples after testing

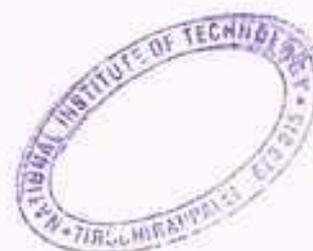
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Table 3. Results of Bend test

Sl. No.	Specimen ID	Observation
1	Ø 8mm	No open discontinuity (no rupture or crack visible at the bend portion)
2	Ø 10mm	
3	Ø 12mm	
4	Ø 16mm	
5	Ø 20mm	
6	Ø 25mm	
7	Ø 32mm	



5. CHEMICAL COMPOSITION

Spark Atomic Emission Spectrometry analysis has been carried out on TMT rods to determine the alloying elements (% wt.) as per IS 228 (Part 18, 19 and 23): 2003 recommended in IS 1786: 2008 standard and the test results are presented in Tables 4 and 5.

Table 4. Results of chemical composition (in wt. %)

Specimen ID	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Cu	V
Ø 8mm	0.21	0.176	0.748	0.024	0.026	0.016	<0.003	<0.005	0.043	0.003	<0.002
Ø 10mm	0.20	0.352	0.886	0.035	0.026	0.009	<0.003	<0.005	0.028	0.002	<0.002
Ø 12mm	0.203	0.275	0.696	0.037	0.026	0.165	0.015	0.087	<0.002	0.174	0.004
Ø 16mm	0.18	0.230	0.881	0.031	0.026	0.016	<0.003	<0.005	0.073	0.003	<0.002
Ø 20mm	0.127	0.220	0.639	0.035	0.022	0.177	0.011	0.036	<0.002	0.108	0.005
Ø 25mm	0.184	0.205	0.586	0.033	0.022	0.137	0.018	0.059	<0.002	0.150	0.002
Ø 32mm	0.230	0.224	0.683	0.034	0.024	0.082	0.006	0.026	<0.002	0.093	<0.002
As per Standard 1786: 2008	Max. 0.25			Max. 0.040	Max. 0.040						

Table 5. Results of chemical composition (in wt. %) - Sulphur + Phosphorus

Specimen ID	S + P
Ø 8mm	0.05
Ø 10mm	0.061
Ø 12mm	0.063
Ø 16mm	0.057
Ø 20mm	0.057
Ø 25mm	0.055
Ø 32mm	0.058



6. MEAN PROJECTED RIB AREA

Mean Projected Area of Transverse Ribs are calculated as per IS 1786: 2008 standard clause 5.4 and the obtained values are represented in Table 6.

Table 6. Results of Mean Projected Area (MPA) of Ribs

Sl. No.	Specimen ID	Observed values in mm ² /mm	As per standard IS 1786:2008
1	Ø 8mm	1.52	0.96
2	Ø 10mm	2.30	1.20
3	Ø 12mm	2.90	1.80
4	Ø 16mm	4.20	2.40
5	Ø 20mm	4.59	3.40
6	Ø 25mm	6.60	4.25
7	Ø 32mm	8.77	5.44



Reference

- IS 1786: 2008 High Strength Deformed Steel Bars and Wires for Concrete Reinforcement – Specification (Fourth Revision)

**** END ****

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