



SHYAM STEEL

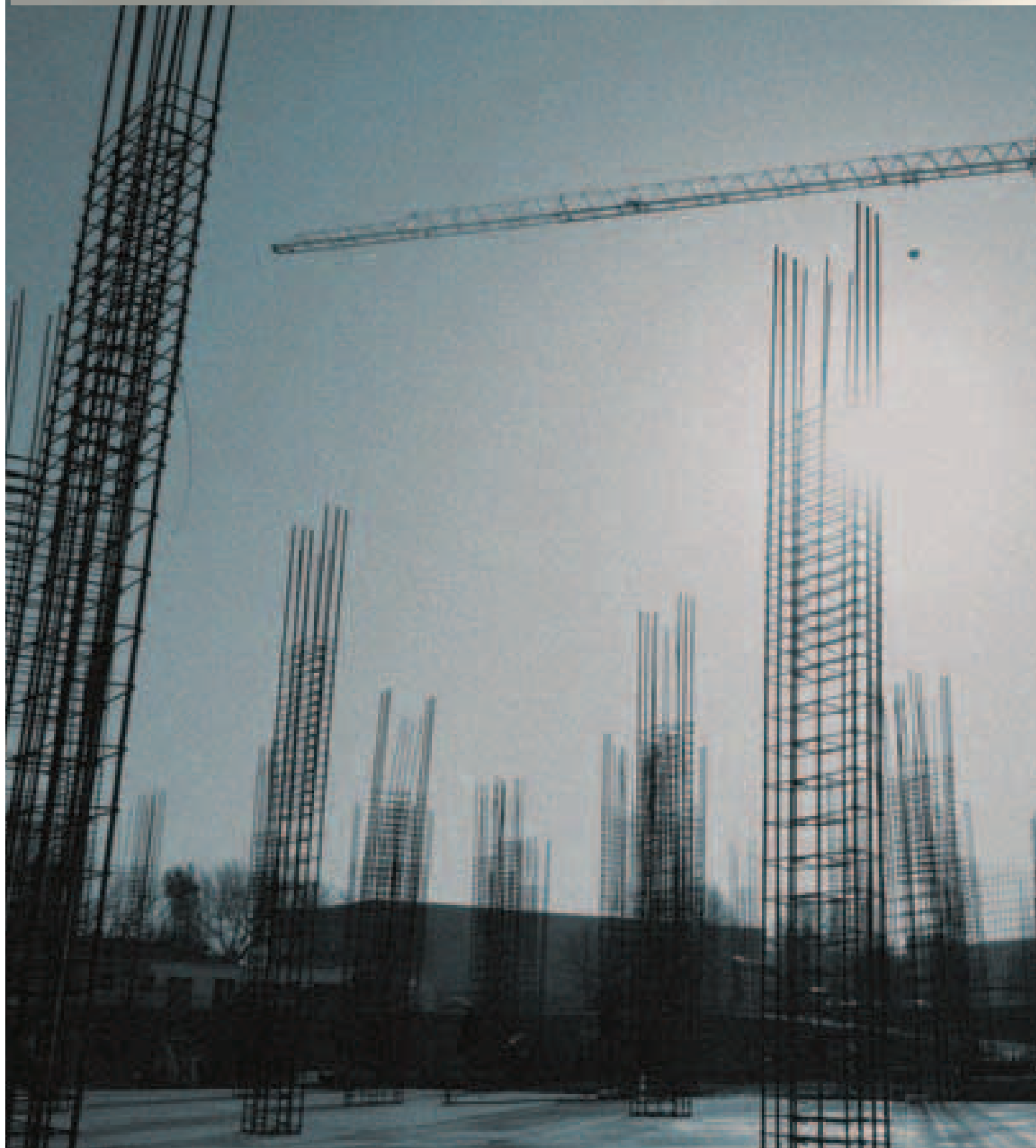
STORAGE & HANDLING

TMT Hand Book

Contents



SHYAM STEEL



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Importance of Proper Handling & Testing of TMT Re-bars

In any RCC construction, TMT Re-bar and cement are the two most important components. The life span and safety of these type of structures entirely depends on the properties of the Re-bar and Cement. Designers / Engineers should accept TMT Re-bars, only after proper testing and verification of the same irrespective of the name of the manufacturer.

Mechanical testing is carried out to produce data, that may be used for design purposes or users acceptance scheme. The most important function may be that of providing design data since it is essential that the limiting values that a structure can withstand without failure are known.

An example of this dual role of mechanical testing is the tensile test that may be used either to determine the yield strength of steel for use in design calculations or

to ensure that the steel complies with a material standard specification.

Mechanical property data are obtained from a relatively small number of standard tests and these will be covered in this article.

The intention of this article is to go beyond the information given in design codes and material standards, and give designers and contractors a greater understanding of Handling and Testing of **Reinforced Steel (TMT Re-bar) at Construction site.**

Storage & Handling: It has been found that storage & handling of Re-bar is a concern at construction sites. Due to lack of proper storage facility we often end up using partially damaged steel.

The inside chapters have been duly verified by industry professionals.



Storage & Handling of TMT Re-bars at Site

Handling and storing TMT Re-bars at construction sites involve diverse operations such as Unloading, Hoisting; Stacking; Cutting; Bending; Fabrication; Welding etc. The efficiency of handling and storing of TMT Re-bars are vital to the industries. Improper handling and storing of materials often results in injuries. If the reinforcement in concrete is not of proper quality and / or is not accurately handled / fabricated, the performance of the structure gets affected.

TMT Re-bar therefore plays a vital role in ensuring the safety, integrity and durability of almost all concrete structures. It can only perform the role satisfactorily if the following points are maintained properly at site:

- Proper Storage, Handling, Cutting and Bending
- Quality Checking
- Proper and accurate Welding / Fixing
- Cleaning Re-bar before concreting

Stacking & Storing of TMT at Site

Storing TMT Re-bars at construction site in proper way is very important to maintain the quality of the product. Generally, steel is sensitive to water moisture and dust. Steel is affected if it comes in direct contact with water, moisture and dust. Covered shed and provisions for covering the bars with Polythene sheets should be available at site to protect the same from moisture attack.

Stacking of TMT Re-bars is very important from quality point of view. The stacking height should be optimized for different dia bars. The more the stacking height, the more load on the bars at the lower layers. Excessive load may damage the 'Ribs' (Transverse & Longitudinal), which in turn will affect the 'surface characteristic' of the Re-bars, as a result of which Tensile Strength and Bond Strength is reduced.

All materials should be bundled and stored in tiers. The bundled Re-bar should be stacked, interlocked and blocked from all sides. The stacking height should be maintained so that it is stable and secured against sliding or collapsing.

To avoid direct contact with earth, suitable raised platform made out of wood blocks should be available at site. Each layer of the bundles should be separated with wooden blocks at suitable interval for uniform load distribution.

For easy handling & identification, a systematic housekeeping procedure should be maintained. Re-bars of different Dia & Grades should be stored separately. Display boards are placed at the right location to identify required product with least effort. The identification tags of the bar manufacturer attached with every bundle of Re-bars Indicating Cast No., Lot No. Grade and Size should be easily visible.

Rough handling, shock loading and dropping of reinforcement bar from a height should be avoided.





Bending and Re-bending at Site

TMT may break at site during handling and welding. In most of the cases it has been found that due to incorrect bending and handling of the bars by the fabricators, the Re-bar gets deformed and breakages happen.

So, one must be careful while bending and re-bending the TMT at construction sites. When bending or re-bending is done at a construction site, it is to be ensured that the bend radii are not formed below the prescribed minimum sizes in the relevant standards. Incorrect bending can severely affect the performance of steel reinforcement in service.

Bending a Re-bar should be gradual and slow, not with a jerk. Bends made on a bar-bending table or block are usually too sharp, and the bar is somewhat weakened and develops cracks at the tension side. Therefore, certain minimum bend diameters have been established for different bar sizes.

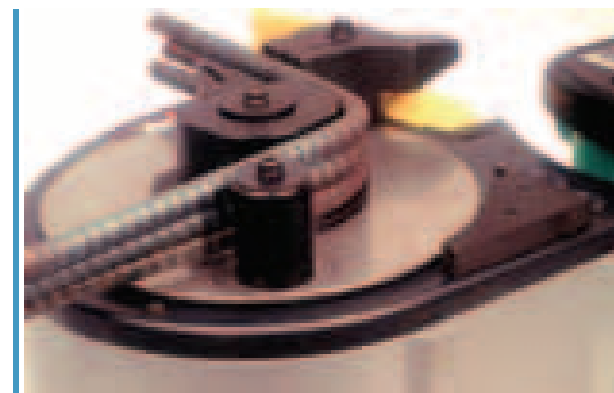
Bending with the aid of a plain pipe and hammer is not acceptable.

Re-bending of TMT Re-bar at site should be done very carefully, because improper re-bending may result in cracks / fracture on the Re-bar. But occasions do arise

on site where re-bending is unavoidable. In all such cases, pre-heating and suitable equipment should be used.

It is recommended that Cutting, Bending and Fabricating of Steel Reinforced Re-bar should be carried out by a specialist reinforcement fabricator, to achieve consistency and accuracy.

TMT Re-bar should be checked for loose scale, mud and oil. Mud and dirt should be washed off before the Re-bars are placed in the forms as they could be detrimental to bond and to the quality of the concrete. Light rusting and mill scales should be cleaned by brush application.



Checking Rusted Re-bars at Site

Mill Scaling is a common problem and light rusting of Re-bar at plant and during transportation. In general, people do not differentiate between light rusting and corrosion / pitting. Light Rusting / Mill Scaling is normally a uniformly spread surface phenomenon and not harmful. Pitting corrosion occurs randomly and is a highly localized form of attack on a metal surface, characterized by the fact that the depth of penetration is much greater than the diameter of the area affected.

Pitting is one of the most destructive forms of corrosion.

However, if there is too much of scaling then the weight of the bar is reduced or the height of the deformations is reduced to below the applicable standards. This type of rusting is considered harmful. It is therefore important to measure the weight loss of Re-bar at site before fabrication.

Testing of Acceptable Limits of Light Rust & Mill Scaling

Measuring the loss of cross sectional area and nominal mass of a Re-bar because of light rusting, can determine whether the same will be acceptable or not. To measure the nominal mass of the rusted bar at site, following steps are to be followed:

1. A minimum of 0.5 m long TMT bar is cut.
2. The sample is cleaned and the loose scales are removed with the help of a brush.
3. The length (L mm) is measured.
4. The Weight (W gm) of the sample is taken with the help of an electronic weighing machine.

5. The Mass (Kg.) per Meter run is calculated by dividing Weight by Length (Lmm).

6. The Cross Sectional area of the sample is calculated as:

$$A_e = \frac{W}{0.00785 \times L} \text{ mm}^2$$

Table-1

Where A_e = effective cross section area, W is the weight of the TMT, L is the length of the TMT.

Compare the result of 5 and 6 for nominal mass and cross sectional area with Table-1. If the values are within the tolerance limits then the material is considered to be acceptable and may be used safely.

Identifying a Sound TMT Re-bar at Site

It is very important to distinguish and identify good quality quenched & tempered Re-bars. Properly quenched Re-bar ensures better tensile strength & elongation. To ensure that the Re-bars have a concentric Tempered Martensite periphery with a softer Ferrite-Pearlite core structure the following points are important:

- a. Quenching Technology used by the manufacturer should be authorised by competent organisation.
- b. Manufacturer of Re-bar should have proper licence for the specific Quenching Technology.
- c. A Licence from B.I.S. ensures good quality.



Testing Process

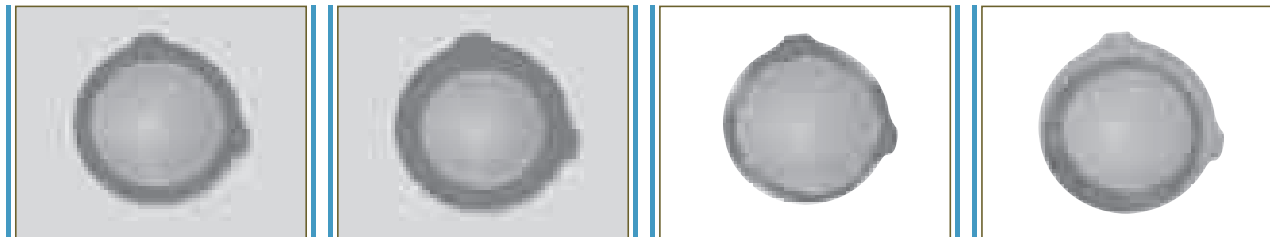
Macro Etching test (Ring test)

A random TMT with a cross section of 25 mm / 30 mm is drawn per lot wise by an abrasive cutter. The ends of TMT are then polished with emery paper and cloth. The polished part of TMT is then dipped in nitral solution (10% Nitric acid with 90% ethyl alcohol). The result should show a uniform tempered martensite periphery with a softer ferrite and pearlite core. This is also called Etching test or Ring test.





Ideal Q & T Re-bars



Re-bars have a UNIFORM Martensite periphery (15-30% of area). Softer ferrite-pearlite core.

OVER QUENCHED
Poor ductility.

NON-UNIFORM HARDENED periphery.
> Due to incorrect mill operation.
> Improper quenching system.

ECCENTRIC Periphery.
> "hit & trial".
> Variation in properties from bar to bar.

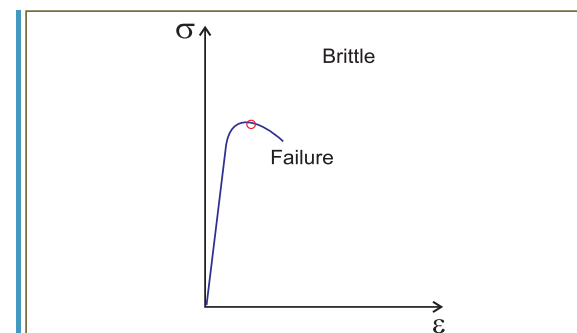
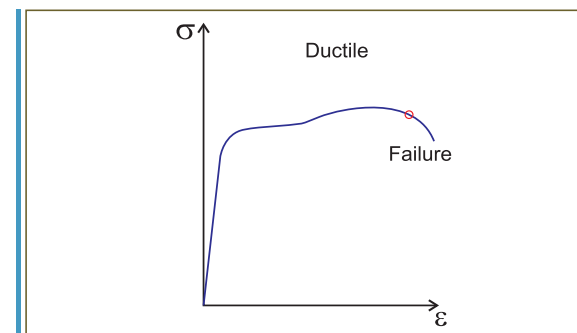
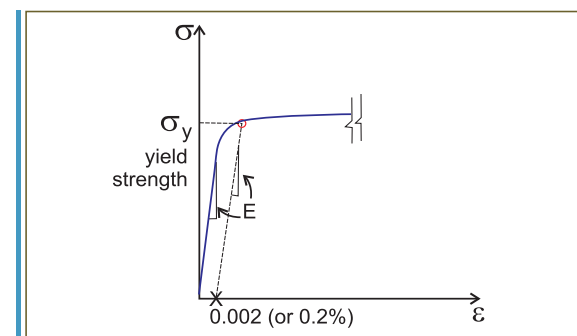
Determination of Yield Stress / 0.2% Proof Stress

The yield strength or yield point of a material is defined in engineering and material science as the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically & will return to its original shape when the applied stress is removed. Once the yield point is passed some fraction of the deformation will be permanent & non reversible.

Offset yield point (yield strength/ proof stress) is the stress at which a non-proportional elongation equal to 0.2% of the original gauge length takes place.

The yield stress is not very well defined and for this reason a standard has been developed to determine its value. The standard procedure is to project a line parallel to the initial elastic region starting at 0.002 strain. The 0.002 strain point is often referred to as the 0.2% offset strain point.

The behavior of the material can be broadly classified into two categories, brittle and ductile. Steel and aluminum usually fail in the class of ductile materials. Glass and cast iron fall in the class of brittle materials. The two categories can be distinguished by comparing the stress-strain curve.



Tensile Test Procedure as Per IS:1608-2005

Specimen Preparation:

Sample Cutting and Calculation of Effective Cross Section

Cutting/preparing and measuring sample length (L) and weight (W) is very important for calculation of effective cross sectional area of a TMT Re-bar. While cutting a TMT Re-bar for testing, it should be ensured that both the end surface should be smooth and perfectly perpendicular to the bar axis as shown in the fig.2. Inclined or irregular end surface may give wrong result.

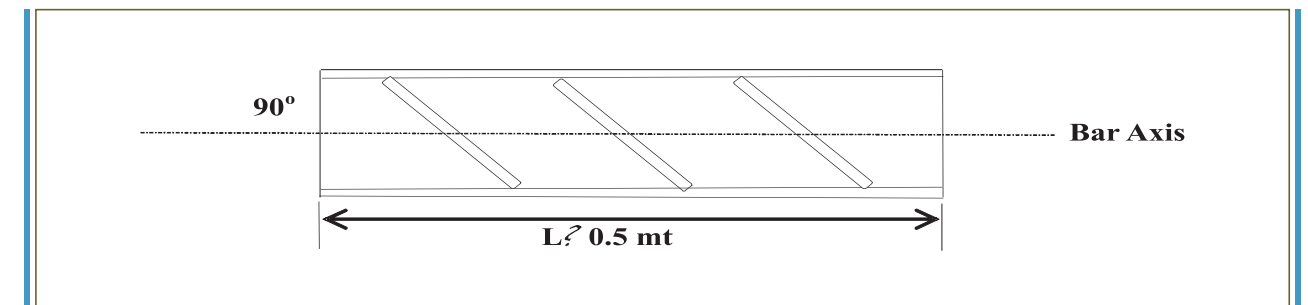


Fig. 2: Sample cutting for mechanical testing

Since the cross sectional area of a TMT Re-bar varies along the length, minimum sample length should be 0.5mt. The effective cross sectional area (A_e) of a TMT Re-bar may be calculated as follows:

$$A_e = \frac{W}{0.00785 \times L} \text{ mm}^2$$

The density of steel is to be taken 0.00785 kg/mm² of the cross sectional area per mt. run as specified in IS-1786-2008.

Where A_e = Effective Cross Section Area, W is the Weight of the TMT, L is the Length of the TMT.

A **Universal Testing Machine** is a material testing machine, which is used to test the tensile and compressive properties of materials.

Determination of 0.2% Proof Stress / Ultimate Tensile Strength / Elongation / TMT Re-bar As Per IS:1786/2008

Apparatus:

(a) Universal Testing Machine (600 & 1000 KN) (b) Steel scale (1mm div) (c) Vernier Caliper (LC=0.02 mm)

(d) Slide Caliper (350 mm approx)

Calculation:

Determination of the cross section area of TMT Re-bar.

(a) Weight of the Re-bar of 500mm = X mm (b) Length of the Re-bar (Area in mm² = Weight / Length x 0.00785)

Reference:

IS:1786 / 2008 (Clause 6.3.1)

$$\text{Ultimate Tensile Strength} = \frac{\text{Ultimate Tensile Load (KN)}}{\text{Cross Sectional Area (mm}^2\text{)}} \text{ in (N / mm}^2\text{)}$$

$$0.2\% \text{ Proof Stress} = \frac{\text{Applied load at 0.2\% elongation on G / L}}{\text{Cross sectional area}}$$

[Ref: IS 1608/2005 (Clause 13) for 0.2% Proof Stress]

$$\text{Elongation\% on } 5.65\sqrt{S_o} = \frac{(\text{Elongation Length- Gauge Length}) \times 100}{\text{Gauge length}}$$

Special Note

- Before testing, M/C should be cleaned and checked
- At the time of gauge length marking marked point should be checked by vernier caliper
- The suitable load rate should be established before applying the load.

Minimum Yield Stress and Tensile Strength for different grade of TMT Re-bars are mentioned below as per IS-1786/2008

Property	Grade						
	Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600
Yield Stress/ 0.2% Proof Stress. (Minimum) N/mm ²	415	415	500	500	550	550	600
Tensile Strength, Minimum	10% more than 0.2% PS, but not less than 485.0 N/mm ²	12% more than 0.2% PS, but not less than 500.0 N/mm ²	8% more than 0.2% PS, but not less than 545.0 N/mm ²	10% more than 0.2% PS, but not less than 565.0 N/mm ²	6% more than 0.2% PS, but not less than 585.0 N/mm ²	8% more than 0.2% PS, but not less than 600.0 N/mm ²	6% more than 0.2% PS, but not less than 660.0 N/mm ²

Determination of Percentage Elongation After Fracture

Elongation (A) is the measure of a steel's ability to deform prior to fracture. Percentage Elongation after fracture for all sizes of deformed Re-bars determined on Effective Cross Sectional Area shall be determined in accordance with the following point:

- In the tensile test, uniform elongation of the test piece is obtained till the tensile force exceeds its maximum and total elongation is obtained and the specimen fractures.

- Test sample, the original gauge length of which is related to the original cross sectional area by the equation: $L_o = 5.65\sqrt{S_o}$ are called proportional test pieces.

Where L_o = Original gauge length. S_o = Cross sectional area of the material.

That means, $L_o \approx 5D$, [D= dia. of the material.]

Gauge length marking on the test piece to be done very carefully before the tensile test, with metal punch as shown in Fig. 4. The tension test specimen shall be gauge marked with a center punch near the middle of the specimen. The purpose of the gauge mark is to provide reference points for determination of the percent of elongation. Punch marks shall be light, sharp, and accurately spaced.

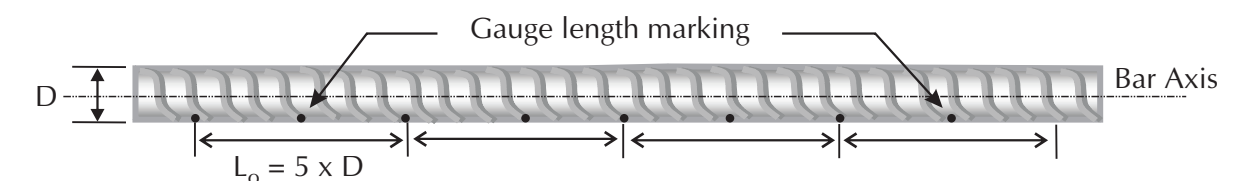
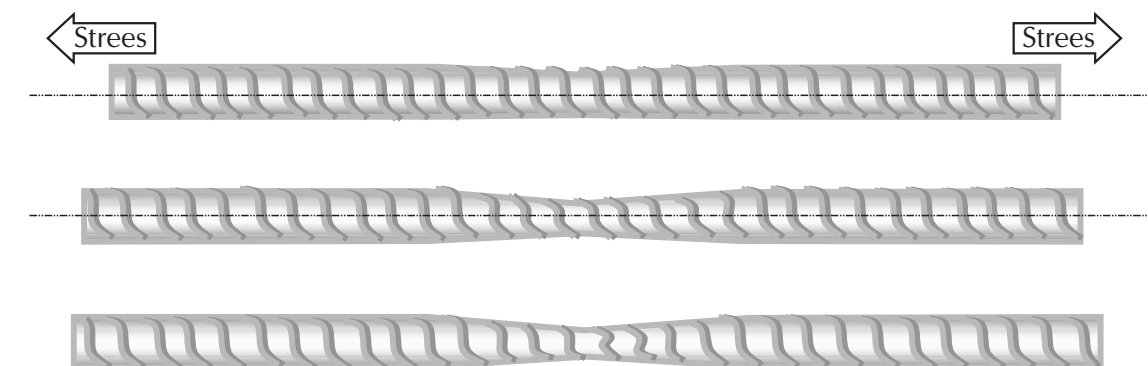


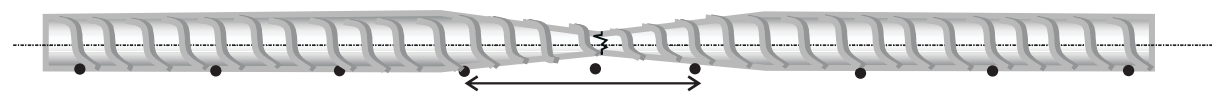
Fig.-4: Test piece Before tensile test

- After proper marking, the test is made by gripping the ends of standardized test piece in a tensile test machine and then applying a continuous increasing uni-axial load until such time as failure occurs. Different phases of the test piece under tensile test are shown below,



Different phases of the test piece under tensile test

- After the tensile strength testing, the two broken pieces of the test piece are again carefully fitted together so that their axes lie in a straight line. Then the final gauge length (L_U) is measured with a Vernier Caliper with maximum accuracy.



L_U = Final gauge length

Two broken pieces placed together after fracture

- Highest level of perfection should be maintained during marking and measuring the original gauge length (L_0) and final gauge length (L_U)
- Special precaution shall be taken to ensure proper contact between the broken parts of the test piece when measuring the final gauge length. This is particularly important in the case of test pieces of small cross section and test pieces having low elongation value.
- Measuring & Testing Instruments/Equipments should be properly calibrated
- Calculation of Percentage of elongation (A) after fracture,

$$A = \frac{(L_U - L_0)}{L_0} \times 100 \%$$

Where L_0 = Original gauge length.

L_U = Final gauge length.

- Standard minimum elongation percentage on gauge length for different grade of TMT Re-bars are mentioned below as per IS-1786/ 2008

Property	Grade						
	Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600
Elongation percentage (minimum)	14.5%	18.0 %	12.0%	16%	10.0%	14.5 %	10.0%
Total Elongation at Maximum Force, percentage (minimum)		5.0%		5.0%		5.0%	

Bend Test

(CI No 9.3 of IS 1786/2008)

Most reinforced steel will require bending, before being used in a concrete structure. Because they are relatively high strength steels, and the ribs on the bar surface act as stress concentrators, reinforcing steels may fracture on bending if the radius of bend is too tight.

The bend test consists of bending a test sample of TMT Re-bar through plastic deformation by applying a load against a suitable **mandrel** until a specified angle (180°) of bend is reached. Depending on the requirements of the material standard such as **IS 1786 / 2008**; it should be parallel at a specified distance, an insert is used to control this distance. Test is usually carried out at room temperature and the bending arrangement with two supports (S_1 & S_2) and a Mandrel (M) has been shown below.



The length (L_1) of the test piece depends on the diameter (Φ) of the Re-bar and the Test equipment used. If the distance (L_2) between the supports are not specified, then L_2 can be calculated as follows:

$$L_2 = Md + 3\Phi \quad [Md = \text{Mandrel Diameter}]$$

The mandrel diameter used for different grades of TMT Re-bar for Bend test are given below as per **IS 1786-2008**

Nominal Size	Fe 415/415D	Fe 500/500D	Fe 550/550D	Fe 600
Up to & Including 10 mm	5 Φ	4 Φ	7 Φ	6 Φ
Over 10 mm	4 Φ /3 Φ	5 Φ /4 Φ	6 Φ /5 Φ	6 Φ

Note: Where Φ is the diameter in mm of the test sample.

Remarks: The sample shall be considered to have passed the test if there is no rupture or crack visible at the bend (tension zone) portion to a person of normal vision.

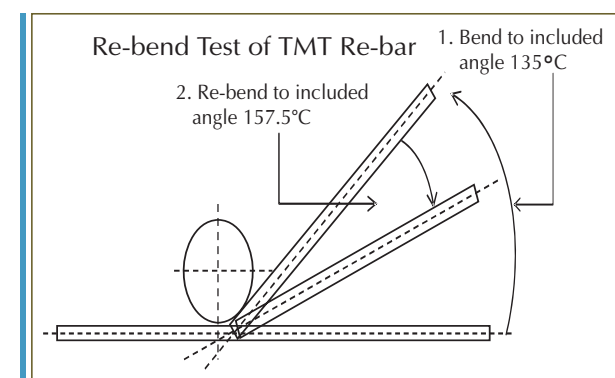


Re-Bend Test

This test is designed to measure the effect of strain ageing on the steel. Strain ageing is an embrittlement effect, which occurs after cold deformation, by the diffusion of nitrogen in the steel. The risk of fracture on bending is increased as the temperature is decreased, because these steels have decreasing toughness at lower temperatures. **Hence temperature parameters should be followed as per code for correct result.**

The Re-bend test consists of bending a sample of TMT Re-bar through plastic deformation by applying a load against a suitable mandrel to an included angle of **135°**. The bend sample should be aged by keeping in boiling water (**100°C**) for **30 minutes** and then allowed

to cool. The sample should be bent back to have an included angle of **157.5°**. Test is usually carried out at room temperature. The mandrel diameter used for different grades of TMT Re-bar is given below.



The sample which has been used for bend test is not to be used for Re-bend test

While applying load on the sample bar one should ensure that the load is uniform, smooth and vertically downwards. **Impulse load should be avoided.**

The specified mandrel diameter used for different grades of TMT Re-bar for Re-bend test are given below as per **IS 1786-2008**

Nominal Size	Fe 415 & Fe 500	Fe 415D & Fe 500D	Fe 550 & Fe 600	Fe 550D
Up to & Including 10 mm	5Φ	4Φ	7Φ	6Φ
Over 10 mm	7Φ	6Φ	8Φ	7Φ

Note: Where Φ is the diameter in mm of the test sample.

Remarks: The sample shall be considered to have passed the test if there is no rupture or crack visible at the bend (tension zone) portion to a person of normal vision.

Chemical Analysis of Re-bar

Instrument

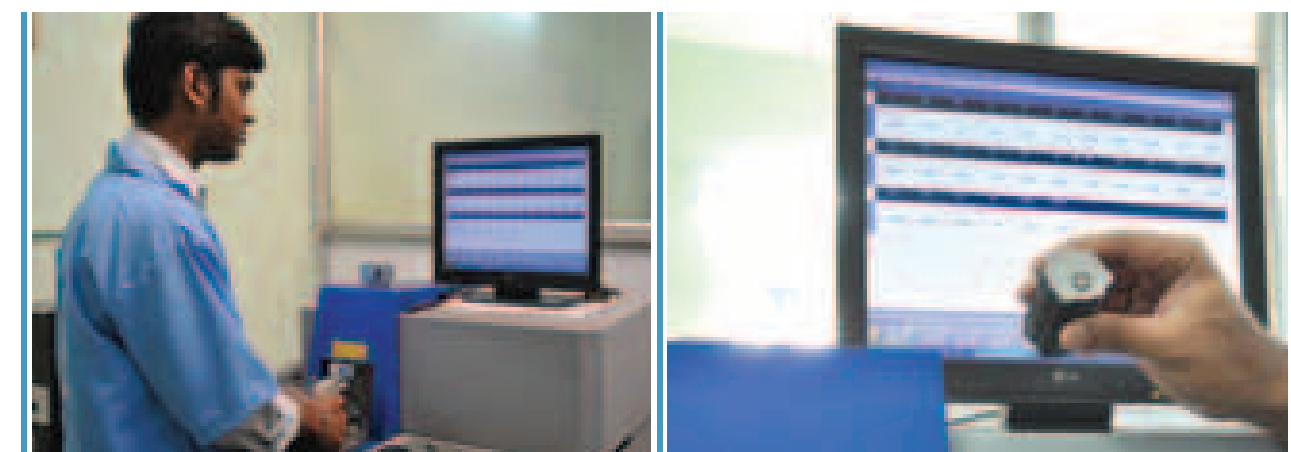
The finished TMT Re-bar is tested for various elements or compositions using Spectrometer. Spectromax using arc and spark excitation is the preferred method to determine the chemical composition of metallic samples. This process is widely used in the metal making industries. Due to its rapid analysis time (10 to 15 seconds) and excellent accuracy, CCD (Light sensitive electronic detector converting light into electric changes) are highly effective in controlling the composition of metal. These spectrometers are used in the quality control of metal processing where a chemical composition of the metallic material is most important. The spectrometer should be standardized every day before use, with a standard sample. These spectrometers are well supported by Certified Reference samples CRM.

Process:

Cross section wise 50mm/60mm length sample cutting from TMT Re-bars by abrasives, grinded and polished one side is used for chemical composition testing in a spectrometer. The spectrometer takes 10 to 15 seconds to give results in printed form of a maximum of 26 elements in the TMT. The spectrometer mainly gives the results of the percentages of carbon, sulphur, and phosphorus which are important as per BIS. In case of micro alloyed grade TMT, percentages of chromium, copper, manganese etc. are also shown by the spectrometer.

The maximum allowable percentages of different elements as mentioned in the IS: 1786-2008 are as below:

Elements	# Percent, Maximum			
	Fe 415/415D	Fe 500/500D	Fe 550/550D	Fe 600
Carbon	0.30/0.25	0.30/0.025	0.300/0.025	0.30
Sulphur	0.060/0.045	0.055/0.040	0.055/0.040	0.040
Phosphorus	0.060/0.045	0.055 /0.040	0.050/0.040	0.040
Sulphur & Phosphorus	0.110/0.085	0.105 /0.075	0.100/0.075	0.075



Permissible tolerance as per Standard



Surface Characteristic

Unlike any other performance characteristics, bonding is a composite characteristic of a Re-bar in any particular re-enforced concrete. Reinforced steel standards specify bond performance by either measurement of rib geometry or by standardized bond / pull out test.

Arguably the most important property contributing to a successful reinforced concrete structure is the bond strength between the reinforcing steel Re-bar and the concrete. A strong bond must be developed in order for the concrete to achieve its designed capacity. Factors that influence the strength of reinforced concrete include, but not limited to, are bar diameter, the absence or presence of bar surface deformations (ribs), the geometry of the ribs, concrete cover over the bars, and the orientation in the concrete matrix.

The minimum value of mean projected surface area (mm^2) per unit length (mm) of the ribs above the core of the TMT Re-bar has been specified in IS-1786-2008

for better bonding with concrete. These values are as given below

- 0.12 Φ for $\Phi \leq 10$ mm
- 0.15 Φ for $10\text{mm} < \Phi \leq 16$ mm
- 0.17 Φ for $\Phi > 16$ mm

Where Φ is the nominal diameter of TMT Re-bar in mm.

The different parameters required to calculate the mean projected surface area has been

show in Fig. 11

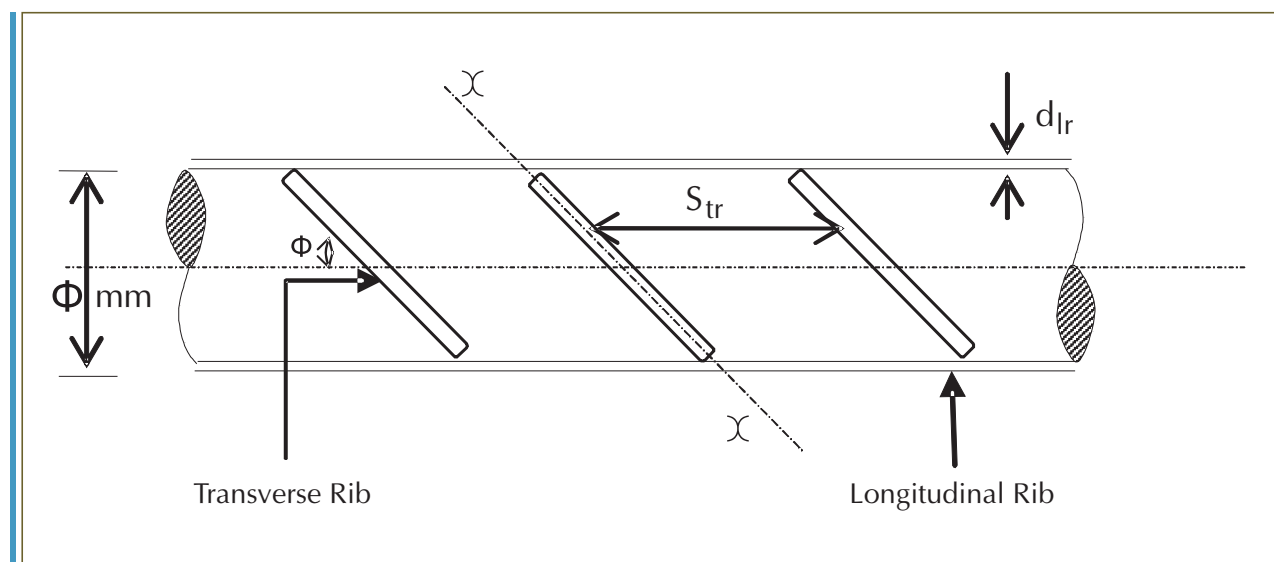
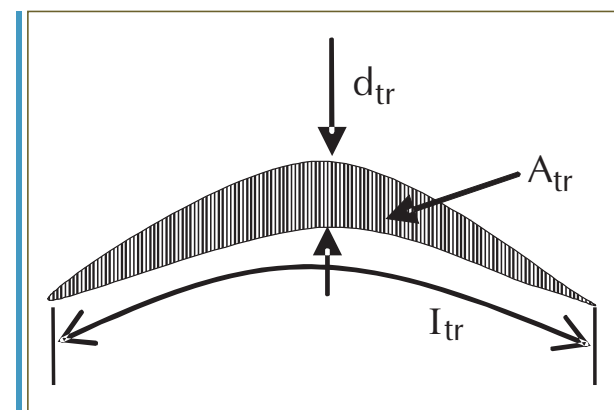


Fig.11 : Sectional Area, Height and Length of a Transverse Rib

Weldability

The term weldability has been defined as the capacity of a metal or alloys to be welded into a specific suitably designed structure and to perform satisfactorily in a given service condition. This means, that if a particular metal is to have good weldability, it must be welded readily so as to perform satisfactorily in the fabricated structure. However, the real criterion in deciding the weldability of a metal is the weld quality and the ease with which it can be obtained.

Weldability depends on one or more of five major factors:

- Melting point,
- Thermal conductivity,
- Thermal expansion,
- Surface condition, and
- Change in microstructure

If these metallurgical, chemical, physical and thermal characteristics of a metal are considered undesirable with respect to weldability, they may be corrected by proper shielding atmosphere, proper fluxing material, proper filler metal, proper welding procedure, and in some cases by proper heat treatment after weld deposition.

Empirically, derived expressions are commonly used to predict weldability of steel. Carbon equivalent equations are hardenability type expressions used for predicting weldability of various parent metal by correlating alloy content and cracking susceptibility during welding. A commonly used carbon equivalent equation is given below

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Ni+Cu}{15}$$

Alloys with CE > 0.45 % are welded with a preheat.

For steel, when alloy are not used with CE 0.42, the material can be welded without any defect or susceptibility to cold cracking. No preheating is required. The amount of carbon content in steel has been a major deciding factor for engineers, as a minimum level of carbon content in steel is essential to achieve the required strength, At the same time, an excess of carbon content

threatens, its property of weldability. However, in TMT Re-bars, this problem has been eliminated by restricting carbon content.

In these Re-bars, the carbon content is maintained 0.2% in order to attain good weldability and at the same time the required strength is also obtained. Further, the joints can be welded by ordinary coated electrodes using MMAW process and no extra precautions are required.

In case of TMT Re-bar, it is welded with low hydrogen electrode (E7018). The microstructure of weld deposits consists of Acicular Ferrite (AF) along with ferrite & pearlite. The fine grained randomly oriented A.F gives higher strength (Y.S, UTS) as well as toughness. The mechanical property of weld deposit of TMT Re-bar is even better than that of Re-bar itself.

The heat affected zone width is very small. In fact the tempered martensite of TMT Re-bar (surface portion) is further coarsened during the heating and cooling cycle. This overall structure is Tempered Martensite (more ductile) Acicular Ferrite along with the ferrite & pearlite in the weld deposit. This type of microstructure produces best combination of strength and bendability.

Since width of the HAZ is small, the original structure and property of Re-bar is not affected beyond weld zone.





Guideline fo Re - bar Welding at Site

Welding of reinforced steel is widespread in the concrete construction industry. The welding of pre-assembled reinforced cages requires sufficient tack welds to ensure that the bars are maintained in proper position and spacing. Generally, the perimeter bar intersections are tack welded to ensure that the product will properly maintain its shape during handling, placement into the casting mould, and pouring of the concrete. In addition, the welding codes require that the work is supervised by a certified weld supervisor and that all of the work is carried out by trained certified welders. The way to avoid problems is to use a weldable grade of Re-bar, correct heat input, and a low-hydrogen welding process.

Key Points to Maintain Structural Integrity in Welded Reinforcing Cages

Manual Metal Arc Welding is still the most convenient process for onsite work. Non-load bearing welds of Re-bars are of two types, the lap joint and the cross joint. This Technical Guidance Note applies to these types of welds.

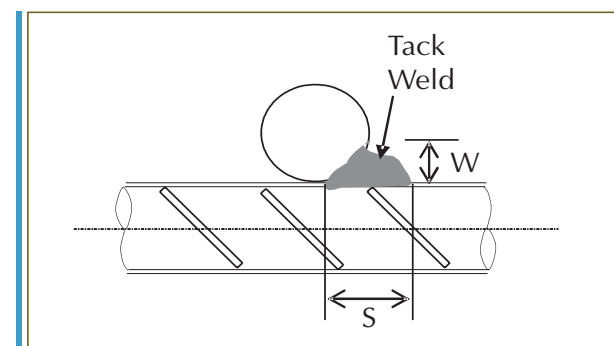
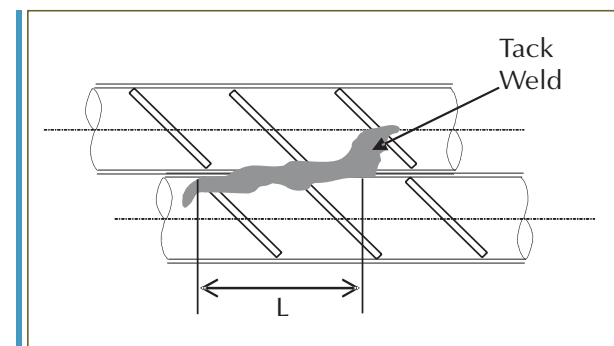
Lap Joint

[S = Size of weld / W = Width of weld / L = Effective length of weld]

Cross Joint

Important Points:

- Selection of Welding Rod
- Selection of proper Current
- Visual Inspection



Basic Approval Parameters for 3rd Party Testing Laboratories

Before sending TMT samples for testing to any third party test laboratories, it is recommended to check the following points regarding that laboratories:

- The testing laboratories must have valid NABL accreditation
- The testing laboratory shall be competent to perform the tests concerned
- Quality related management system should be defined in a quality manual under the authority of the top management
- The testing laboratory shall have properly trained personnel with sound technical knowledge and experience for their assigned functions in the area of mechanical testing
- The testing laboratory should equipped with all equipments / instruments required for accurate performance of the test
- Measuring and testing equipment must be calibrated by any NABL accredited agency before being put into service
- All equipments must be maintained in good condition. Proper maintenance procedure should be available and followed
- Precautions shall be taken at all stages of storing, handling and mounting of test samples to avoid damage of the items

Basic Construction Safety Guidelines

Construction sites are extremely dangerous places to be in. Because of the kind of work involved, the construction workers face high risk of getting injured and are also prone to accidents. Therefore it is essential that people working in these kinds of sites follow some basic important guidelines for their safety as well as safety of others.

Mindsets and Awareness

Safety begins with the way we approach our work on the jobsite. When we are conscious about the safety of ourselves as well as others, we are much more likely to avoid accidents.

- **THINK** safety measures before starting your work at site.
- When uncertain about how to do a task or operate a tool, **ASK** a supervisor.
- Always **CONCENTRATE** on the task at hand.
- **KNOW** where the first-aid kit is located and how to get emergency help.
- **INSPECT** all tools, ladders and scaffolding before using.
- **INFORM** your supervisor immediately of any unsafe condition.

Effective Supervision

Well-trained supervisors will manage well-planned jobs and will ultimately produce safe and productive job sites

- Train your supervisors in human relations skills, behavior-based management, and responsibility toward safe production.
- Make employees accountable for working safely. Just as productivity is valued, so should safe work environments. Make safety a part of every supervisor's performance appraisal.

Protective Equipments

In 90 percent of the accident cases at construction sites, personal protective equipments were either not in use or improperly used, or the employee was not trained with the safety rules.

- Wear safety shoes or boots, preferably with steel toes and shanks.
- Wear a hard hat while framing, shingling, or when required by the supervisor.
- Wear safety glasses when working with any power tool and when recommended by the supervisor.
- Wear dust masks when installing sanding, GI welding or when instructed by a supervisor.





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