SHYAM STEEL

PRODUCT

Evolution through Innovation

SHYAM STEEL

Shyam Steel Industries Ltd

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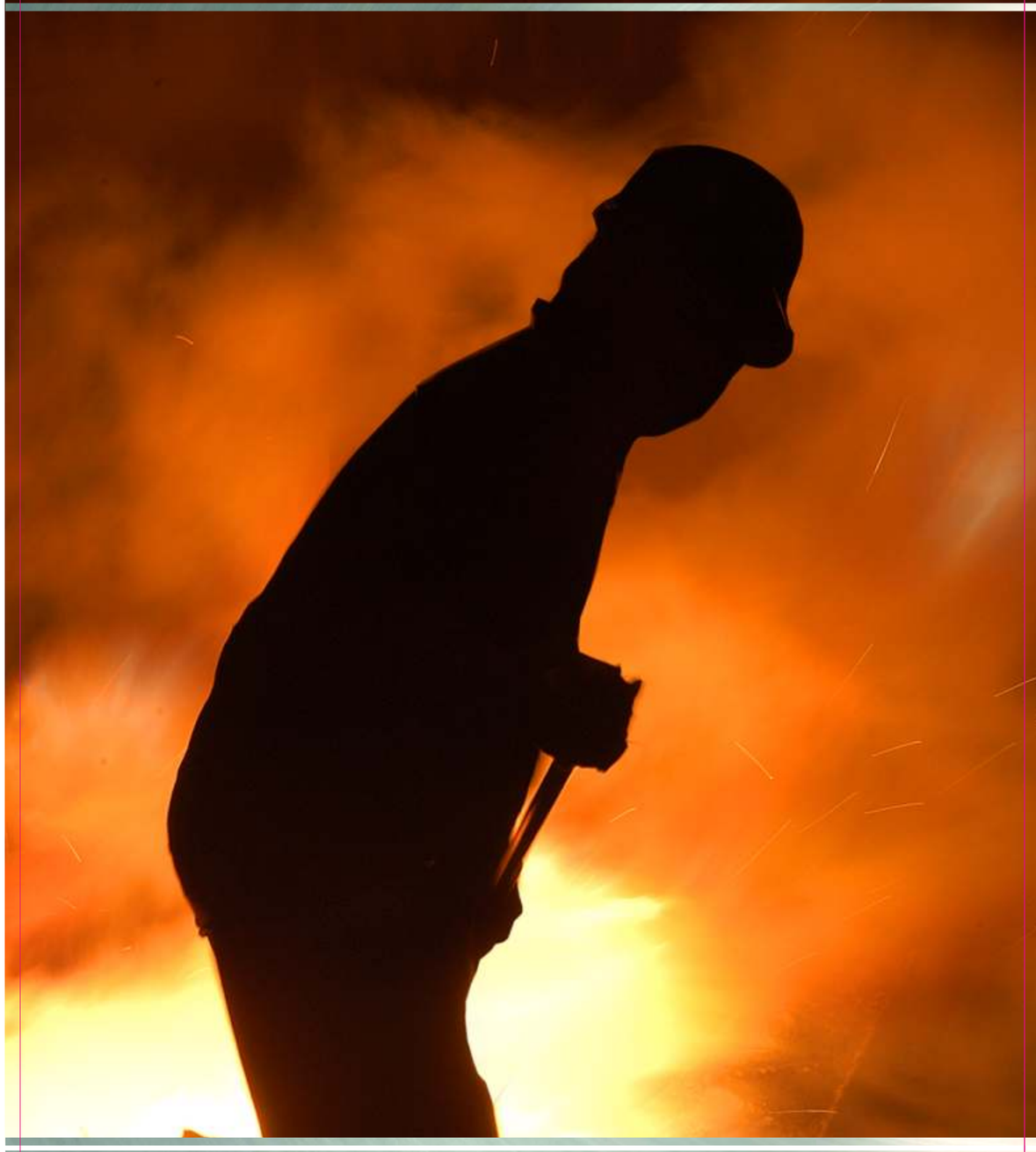
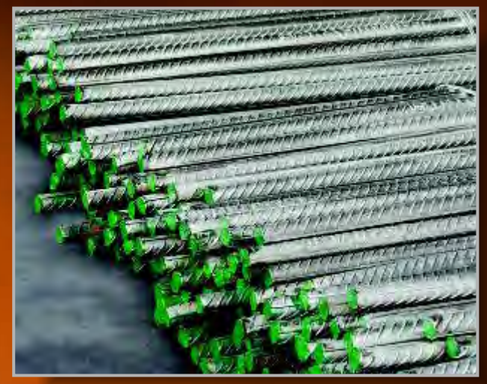
Introduction





SHYAM STEEL

Eastern India's Most Dependable Source for Quality Steel Products

Shyam Steel Industries Ltd offers unique product advantages that result in more productive and profitable steel usage for the end user.

Shyam Steel offers a superior product that comes with a series of inherent advantages. It offers consistency in quality, uniformity in grades, dimensions and tolerances. It also comes with superior stability, high strength-to-weight ratios, properties for higher durability and easy workability. It provides excellent application which works out to give a longer life span to the product.

Shyam Steel currently has four fully operational steel manufacturing units in West Bengal. This includes a state-of-the-art integrated steel plant at Durgapur, with facilities like DRI Unit, EAF, Continuous Billet Casting Mill, sophisticated and high-speed Rolling Mill, microprocessor based product technologies and fully-equipped Quality Assurance & Testing laboratories. The Company also runs a pan India Sales & Marketing network with a highly-efficient and dynamic logistics support system. Shyam Steel aspires to occupy a pre-eminent position in the steel industry by achieving manufacturing excellence and having a consistently satisfied customer base. As a testament to its fine quality products the Company has received ISO-9001, 14001 and OHSAS 18001certifications.

A Growing Range of high quality Steel Products

- Wire Rods
- Billets
- TMT Re-bars
- Structural Steel

Product Mix

Shyam Steel is the only company in the private sector offering the widest range of construction steel. Its range of TMT Re-bars suffices the rarest need of a civil engineer. The range of Structural Steel offered by the company meets the maximum demands of the engineering sector.

TMT Re-Inforcement Bars

TMT Re-bars Fe 415/ Fe 415 D/ Fe 500/ Fe 500 D/ Fe 550/ Fe 550 D/600

8	10	12	16	20	25	28	32	36	40

CRS TMT Re-bars

8	10	12	16	20	25	28	32	36	40

EQR TMT Re-bars

8	10	12	16	20	25	28	32	36	40

Wire Rods

5.5	6	6.5	7	8	9	10	12	12.5

Rounds

10	12	16	20	25	28	32	36	40	45	50	56
60	65	80	90	100	110	120	125	130	140	150	160

Angles			Thickness				
50	x	50	x	6			
65	x	65	x	6	8	10	
75	x	75	x	6	8	10	
90	x	90	x	6	8	10	
100	x	100	x	6	8	10	12
110	x	110	x	6	8	10	12
130	x	130	x	8	10	12	16
150	x	150	x	10	12	16	20

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Flats

20	x	5	upto	200	x	20

Channels

20	x	5
75	x	40
100	x	50
125	x	65
150	x	75
200	x	75
250	x	82
300	x	90

Beams

125	x	75
150	x	75
175	x	85
200	x	100
250	x	125
300	x	140

Billets

100	x	100
125	x	125
150	x	150

Dimensions shown in boxes are in mm unless otherwise stated

Grades

Re-bars : Thermo Mechanically Treated (TMT) Re-Inforcement Bars as per IS 1786 Fe 415, Fe 500, Fe 550, Corrosion Resistant Re-bars and Earthquake Resistant Re-bars

Rounds : Mild Steel as per IS 2062 : 2006 & Bright Bars

Structurals : As per IS 2062 : 2006

Wire Rods : As per IS 7887

Billets : IS 2830, CRS and Special Alloy Grades

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Technology

Manufacturing Process at Integrated Steel Plant

At Shyam Steel, steel is produced through the DRI-EAF route. Billets thus produced are rolled into TMT Re-bars of various sizes and grades. Iron-ore, coal and dolomite are charged in the Sponge iron plant. Iron-ore gets reduced to Sponge iron owing to reaction between carbon in coal and oxides in Iron-ore. The procedures involved in an arc furnace are as follows:

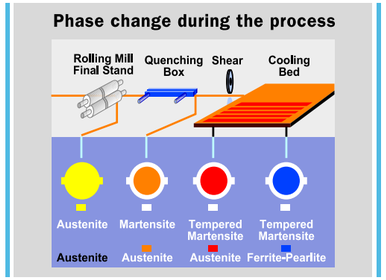
Charging • Melting • Refining • De-slagging • Tapping

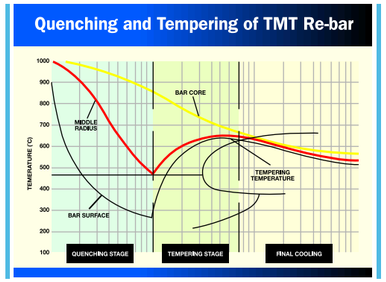
Sponge iron and other ingredients in a close requisite ratio are charged in the arc furnace. Sponge iron is melted in the Electric Arc Furnace. Refining and de-slagging ensure removal of impurities like Sulphur and Phosphorous thereby giving clean steel for casting to billets. Molten steel is then casted to billets of desired lengths. TMT Re-bars are hot rolled from the billets and subjected to thermo-mechanical treatment in three successive stages:-

Quenching • Self Tempering • Atmospheric Cooling

This integrated process ensures consistent quality in steel manufacturing resulting in better quality TMT Re-bars, at the same time differentiating itself from other secondary producers.

Quality





Integrated Quality Assurance System

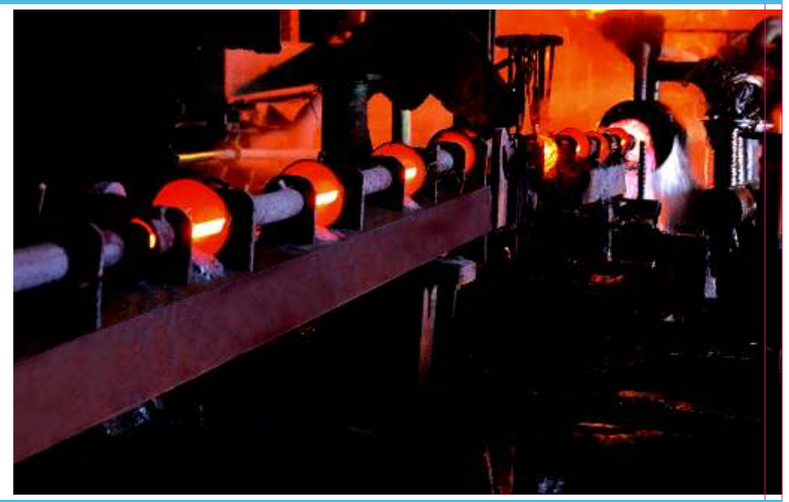
Shyam Steel's in-house DRI Plant and EAF enable total control over chemical composition.

This is complemented by complete automation of rolling mill which ensures consistency in the quenching system. It has documented procedures for inspection and testing of all incoming raw-material and finished products in its in-house metallurgical, chemical and physical test laboratories, equipped with sophisticated inspection and test equipment like Universal Testing machine, Spectrometer, Microscope and other advanced facilities manned by a team of qualified and experienced professionals.

The Total Quality Management System is approved by TUV India Pvt Ltd. Continuous R & D is encouraged and has resulted in substantial product and process quality improvements.

DRI plant

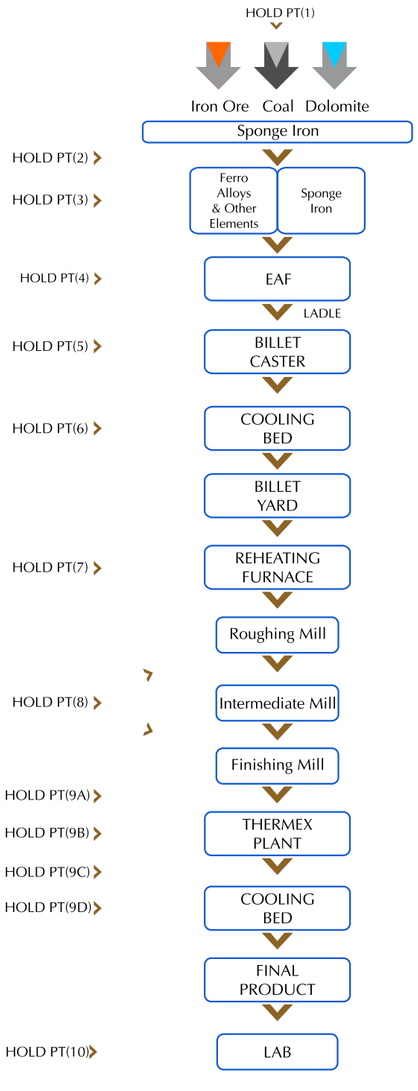
Electric arc furnace



Thermax

Quality

Schematic Diagram of Quality Check



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Hold Point	Activity
1.	Chemical analysis of iron ore, coal, dolomite
2.	Final chemical analysis of sponge iron
3.	Chemical analysis of sponge iron, ferro alloys & other Elements
4.	Refining and deslagging
5.	Chemical analysis and visual inspection of billets
6.	Final chemical analysis of billets
7.	Re-heating furnace temperature check
8.	Splitting tendency check
9a.	Incoming material temperature check
9b.	Water temperature and pressure check
9c.	Outgoing material temperature check
9d.	Equalising temperature check
10.	Final physical and chemical analysis of finished product

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Fe 415/415 D

Cost Advantage

BIS Certified and of superior quality, Shyam TMT Re-bars Fe 415/415 D are high strength thermo mechanically treated Re-inforcement bars. They are produced under controlled and consistent conditions and are recognised as market leaders in this segment.

Features:

Superior Physical Strength

Shyam Steel TMT Re-bars Fe 415/415 D exhibit consistent superior strength and high ductility with much higher limits than specified in IS:1786 which ensure superior structures.

Controlled Chemical Composition

Shyam Steel TMT Re-bars are hot rolled from in-house M.S.Steel Billets which have uniform chemical compositions like low carbon content and high manganese content.

High Bond Strength

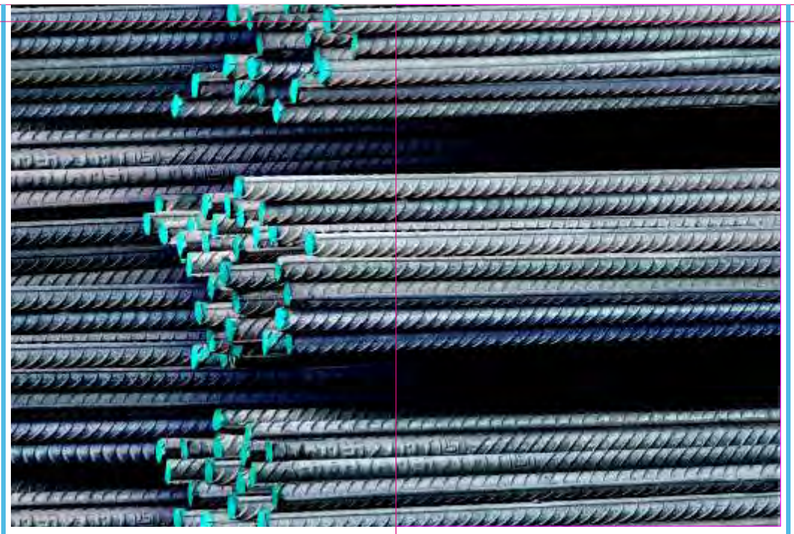
Shyam Steel TMT Re-bars have more prominent ribs and thus have higher AR values up to 100-150% higher than traditional CTD Bars or other TMT Re-bars.

Superior Bendability

Shyam Steel TMT Re-bars are manufactured by the advanced Thermex Process, which results in a tough outer surface and a soft core. This provides the Re-bars good bendability and workability.

Excellent Weldability

Shyam Steel TMT Re-bars have low carbon content, are highly weldable, in comparison to ordinary Re-bars and require no pre or post welding treatment.



High Dimension Tolerance

Shyam Steel TMT Re-bars have section weights very close to the nominal values specified in BIS code. This ensures higher meterage per unit weight of Re-bars as compared to ordinary Re-bars.

Seismic Resistance

Shyam Steel TMT Re-bars support seismic design due to its unique combination of strength, ductility and stress ratio.

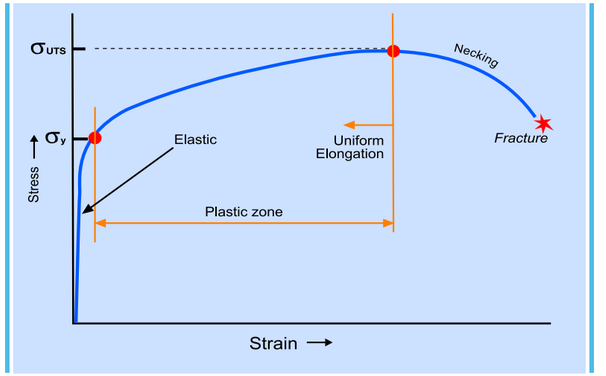
Fire Resistance

Shyam Steel TMT Re-bars suffers no loss of strength even at temp as high as 600°C.

Unique Corrosion Resistance

Shyam Steel TMT Re-bars are free from internal stress, which result in superior corrosion resistant characteristics compared to the traditionally cold-twisted bars and other TMT Re-bars.

Stress Vs Strain for TMT Re-bars Fe 415/415 D



SHYAM STEEL

Fe 415/415 D

Physical Properties

Description	IS:1786 Fe 415	SHYAM 415 TMT Re-bars	IS:1786 Fe 415 D	Shyam 415 D TMT Re-bars
0.2% Proof Stress (min N/mm^2)	415	470	415	470
Ultimate Tensile Strength (min N/mm^2)	485	540	500	580
Total Elongation	—	—	5	6
%Elongation, min	14.5	20	18	22
Bend	3D to 4D	2D to 3D	2D to 3D	2D
Rebend	5D to 7D	4D to 6D	4D to 6D	3D to 4D

Chemical Properties

Description	IS:1786 Fe 415	SHYAM 415 TMT Re-bars	IS:1786 Fe 415 D	Shyam 415 D TMT Re-bars
Carbon (% max)	0.30	0.250	0.250	0.220
Sulphur & Phosphorous (% max)	0.06	0.050	0.045	0.040
S+P (% max)	0.11	0.10	0.085	0.080
Mn (% max)	—	0.60	—	0.070
CE (% max)	—	0.40	—	0.350
Nitrogen (ppm max)	—	—	0.012	0.012

Section Weight Chart

Nominal Size in mm	Weight in Kg/m as per IS 1786
8	0.395
10	0.617
12	0.888
16	1.580
20	2.470

Nominal Size in mm	Weight in Kg/m as per IS 1786
25	3.850
28	4.830
32	6.310
36	7.990
40	9.850

These section weights are applicable for all grades of Shyam TMT Re-bars

Shyam TMT Re-bars are Economically More Viable

Shyam Steel TMT Re-bars are economically more viable compared to other products in the market. A simple calculation of the quantum of steel that ensures the load bearing factor of a single re-inforced beam is given beside.

Type of Structure	RCC Foundation/ Heavy Beam/Slab etc.
Steel specification	IS : 1786, Fe 415/415 D
Steel requirement by using Yield Stress 415 N/mm^2 of other Brand/ CTD Bars	1.00 MT
Shyam TMT Re-bars using Yield Stress 460N/mm^2	0.90 MT
Savings in steel using SHYAM TMT Re-bars	0.1MT (100 Kg)

To sum up - the total quantity of steel saved is 100 kg per MT as compared to other TMT Re-bars.

Applications

Typically, Shyam TMT Re-bars Fe 415/415 D can be used in construction projects such as :

Office and Residential Complexes • Warehouses • Schools • Bridges • Dams • Power Plants

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Fe 500/500 D

High Strength for Critical Applications

The Shyam Steel TMT Re-bars Fe 500/500 D is a special grade of TMT Re-bars produced under specific process conditions resulting in increased tensile strength as compared to Fe 415/415 D grade TMT Re-bars. Fe 500/500 D Re-bars are ideal for applications in heavy load RCC structures like flyovers, dams, bridges and other critical structures where high yield load (design load) is required without compromising on the ductility. In addition to the features of Shyam Steel TMT Re-bars Fe 415/415 D the Fe 500/500 D grade Re-bars exhibit the following characteristics:

Special Weldability

Shyam Steel TMT Re-bars do not require pre or post welding treatment as they have low carbon content and are produced under controlled thermo mechanical treatment.

Higher Corrosion Resistance

The controlled thermo mechanical treatment also results in a uniform and thick tempered martensitic rim, completely free from internal stress. This martensitic rim (thicker than Fe 415/415 D) improves the corrosion resistance as well as fatigue strength of the Shyam Steel TMT Re-bars Fe 500/500 D when compared to other TMT Re-bars.

Cost Advantage

The area of steel in tension of a single reinforcement beam is as follows:

$$Ast = \frac{0.85 \times M \times D}{fy}$$ where,

Ast = Area of steel in tension M = Moment in tension
D = Depth of Section fy* = Stress of Steel in tension

Therefore, it is evident from the above calculations that higher the tensile strength, lesser is the consumption of steel.

Type of Structure	Steel requirement by using Fe415	Steel requirement by using Fe500	Saving in Steel by using Fe 500
RCC Foundation heavy beam, slab, etc	1.00 MT	0.83 MT	170 Kg

*fy values for Fe 415/415 D is 415 N/mm2 and 500 N/mm2 for Fe 500/500 D TMT Re-bars.

By using Shyam Steel TMT Re-bars Fe 500/500 D the effective savings would be to the tune of 17%.

Properties

Description	IS:1786 Fe 500	SHYAM 500 TMT Re-bars	IS:1786 Fe 500 D	Shyam 500 D TMT Re-bars
0.2% Proof Stress (min N/mm^2)	500	540	500	560
Ultimate Tensile Strength (min N/mm^2)	545	640	565	660
Total Elorgation	-	-	5	6
%Elongation, min	12	18	16	20
Bend	4D to 5D	3D to 4D	3D to 4D	2D to 3D
Rebend	5D to 7D	4D to 6D	4D to 6D	3D to 5D
Carbon (% max)	0.300	0.250	0.25	0.22
Phosphorous & Sulphur (%max)	0.055	0.050	0.040	0.035
Phosphorous + Sulphur (% max)	0.105	0.095	0.075	0.065
Mn (% max)	-	0.600	-	0.080
CE (% max)	-	0.400	-	0.350
Nitrogen (ppm max)	-	120	0.012	0.012

* The gauge length for ASTM Standards is 200mm whereas for BS and Indian Standards is 5 D

Applications

Apart from usage in general construction sector Shyam TMT Re-bars Fe 500/500 D find usage in critical applications such as: Power Plant, Hi-Rise Building, Bridge



SHYAM STEEL

CRS

Protection from Corrosion

Corrosion of metal is a natural and rapid phenomenon in areas of high humidity, places close to the sea or in the presence of saline water or gaseous emissions in industrial area.

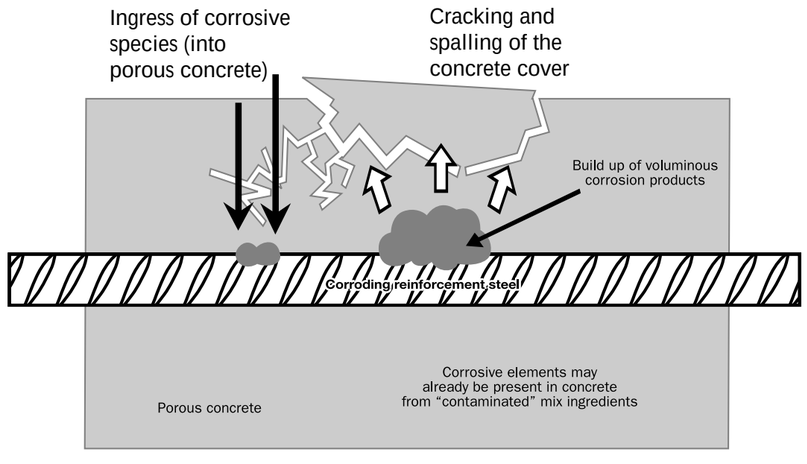
It is a silent and potent menace that can destroy the toughest and best built structures in the world like buildings, bridges, dams, chimneys, jetties, industrial plants, port establishments etc.

When concrete is freshly cast, it contains high ph value (ph value: 12-13). This creates a protective passive oxide layer over the steel surface, preventing it from corrosion.

Gradually, with constant ingress of oxygen, water, chlorides, carbon dioxide etc. the ph value of the concrete drops below 8 causing decay of the protective layer. The chloride ions attack the passive layer on the metal surface exposing it to oxygen and moisture. Once the passive layer is broken the electro-chemical reaction of corrosion progresses unimpeded.

The Impact of Corrosion on Steel-Reinforced Concrete

Any construction of permanent nature requires concrete with steel reinforcement. The durability' of concrete depends on its impermeability to water, oxygen, carbon dioxide, chlorides, sulphates etc. which corrode and weaken the re-inforcement bars leading to spalling of concrete.



Solution

Efforts to control corrosion led to Galvanized and Epoxy coated Re-bars but these failed in practical usage. The solution was to take a new metallurgical route-controlled composition, alloying with anti-corrosion elements and improved production process that would give the steel bars inherent corrosion resistant properties.

Meeting the Challenge

Corrosion resistant elements such as copper and chromium are added to the molten metal to manufacture CRS Billets. Then they are rolled in controlled quenching and tempering process, imparting excellent corrosion resistant properties to the Re-bars.

Properties

Description	Shyam TMT Re-bars CRS
0.2% Proof Stress (N/mm^2, min)	540
Ultimate Tensile Strength (N/mm^2, min)	620
% Elongation (min)	18
Bend	3D to 4D
Re-bend	4D to 6D
C (% max)	0.150
Mn (% max)	1.500
Si (% max)	0.035
P (% max)	0.100
CE (% max)	0.500
CRE (% min)	0.500

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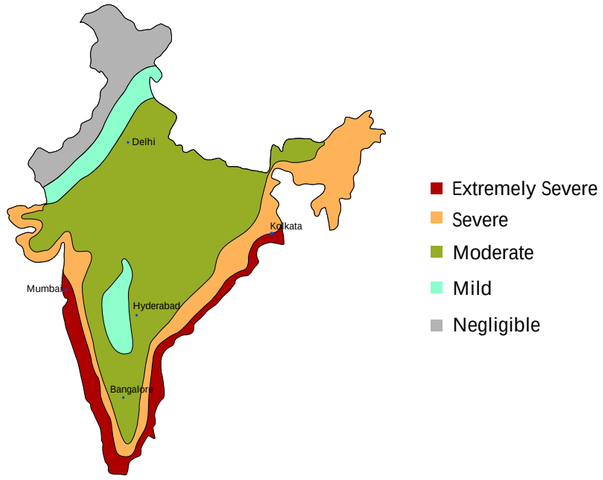
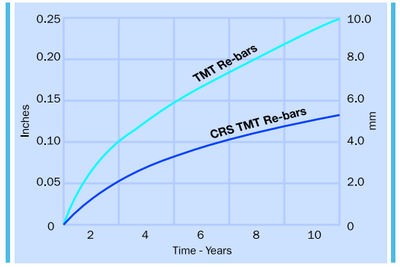
Corrosion map of India*



Special Corrosion Resistance

Shyam Steel TMT Re-bars CRS have been tested in rigorous corrosion media and evaluated for various corrosion resistant properties as per ASTM standards viz. alternate Immersion test, Salt Spray test, Atmospheric Exposure test, Sulphur Dioxide test and Potentio Dynamic test. The result of such corrosion tests indicate that Shyam Steel TMT Re-bars CRS have a minimum Corrosion Resistant Index (CRI) of 1.7 as compared to CRI of other TMT Re-bars. Test results show that Shyam Steel TMT Re-bars CRS show an almost 70% less corrosion than other TMT Re-bars available in the market.



Corrosion Resistance Index (CRI)

Type of Test	Non CRS TMT Re-bars	CRS TMT Re-bars
Potentio Dynamic Test	1.0	2.35
Salt Spray Test	1.0	1.59
Sulphur-Dioxide Test	1.0	1.68
Alternate Immersion Test	1.0	1.92

*by CECRI

Certification

Shyam Steel TMT Re-bars have been tested at a number of reputed national institutes like IIT Kanpur and National Test House, Kolkata under actual service conditions. The field data obtained in actual service condition demonstrates its durability compared to other TMT Re-bars.

Advantages

1. No additional precaution required in material handling and transportation
2. No additional preparation for storage or working at site
3. No maintenance during fabrication
4. Workable at poor site conditions
5. Lifespan cost benefit
6. No extra precaution during welding

Applications

Oil & Gas Exploration Sites • Bridges & Dams • Highways & Flyovers • Sea Ports • Jetties • Thermal & Hydel Power Stations • Industrial Structures • Hazardous Area Constructions

SHYAM STEEL

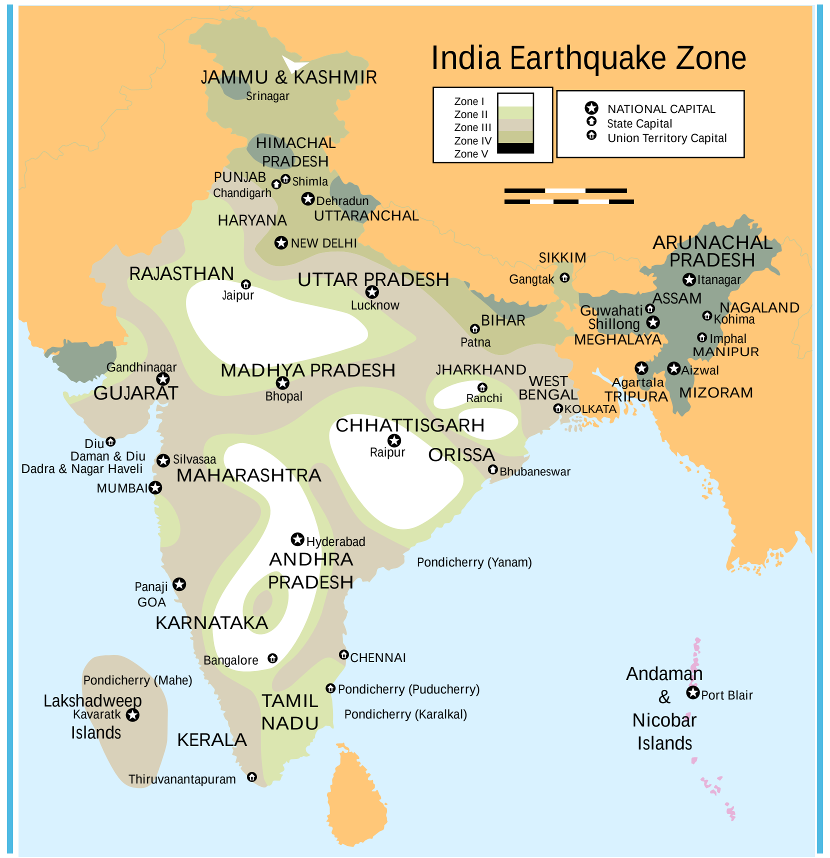
EQR

Earthquake Resistant Structures

An earthquake is a natural phenomenon which causes loss of life and property. India is divided into five seismic zones I, II, III, IV & V of which zone IV & V are highly prone to earthquakes. Shockingly, about 60% of India's land mass is earthquake-prone.

What Causes Earthquakes?

Earthquakes occur along the tectonic plate margins (where plates meet) which form the crust of the earth. When plates move past, towards or away from each other the movement is not smooth. Friction causes the plates to get stuck. This causes pressure to build up. Earthquakes occur when this build up of pressure is released.



Solution

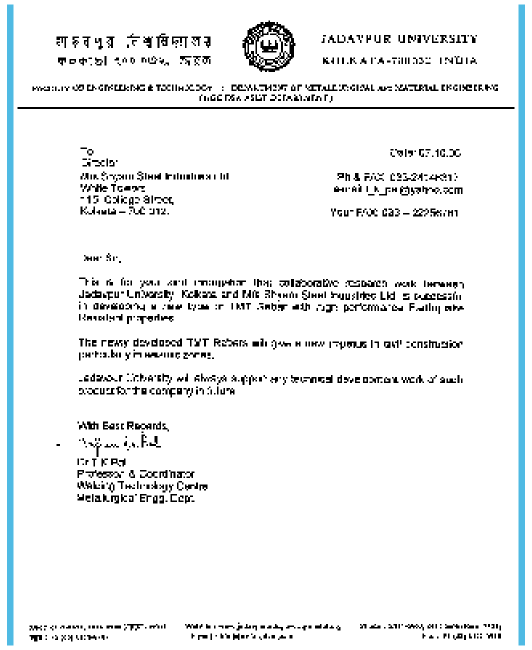
To make structures earthquake-resistant they should possess four virtues, namely:

- Minimum specified lateral strength
- Adequate lateral rigidity
- Good ductility (ability to deform & absorb energy)
- Good seismic structural configuration

Lateral strength and rigidity is addressed by the design engineer using sound design principles. Ductility can be increased for a RCC structure by the use of highly ductile Re-bars.

Specially Designed Metallurgy

Shyam Steel has developed specially treated TMT Re-bars, which can withstand large amounts of tension through plastic deformation before fracturing. This R&D has been done in collaboration with Jadavpur University, Kolkata. These Re-bars are produced in-house by the use of special micro alloyed billets having a different chemical composition and rolled under strict and specially designed conditions using Thermex technology. This results in a UTS/YS ratio greater than 1.2 and a minimum elongation value of 20%.



JADAVPUR UNIVERSITY
KOLKATA-700032 INDIA

With Best Regards,

Professor & Coordinator
Metallurgical Engg. Dept.

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Physical Properties

Physical Properties	IS 1786/85	BS 4449/2005		Australia/New Zealand As NZS 4671/2001		SHYAM EQR TMT Re-bars
	Fe 500	Fe 500B	Fe 500C	Fe 500N	Fe 500E	Fe 500 EQR
Yield Strength (N/mm2, min)	500	500	500	500	500	500
Yield Strength (N/mm2, min)	NS	650	650	650	600	670
Tensile Strength (N/mm2, max)	8% Higher TO Y.S	8% Higher TO Y.S	15% Higher TO Y.S	8% Higher TO Y.S	15% Higher TO Y.S	16% Higher TO Y.S
Tensile Strength (N/mm2, max)	NS	NS	NS	NS	40% Higher TO Y.S	34% Higher TO Y.S
%Elongation (Min)	12.0	NS	NS	NS	NS	16
%Uniform Elong. Upto Max. Stress(min)	NS	5.0	7.5	5.0	10.0	7.0
UTS/Y.S (min)	1.08	–	1.15	1.08	1.15	1.16
Application	General	General	E.Q. Zones	General	E.Q. Zones	E.Q. Zones

Advantages

- High strength & ductility
- Excellent impact toughness
- Good weldability
- Better bendability
- Adequate fire resistance
- Cost benefit

Applications

- Hi-rise Buildings
- Bridges
- Dams
- Hospital Buildings
- School Buildings
- Thermal & Hydel Power Stations
- Other Critical Structures in Seismic Zone III, IV & V

SHYAM STEEL

Round Bars & Structurals

The range of Structural Steel offered by the Company meets the demand of the engineering sector and has wide acceptance in power, telecom, precision engineering and other allied industries. The sections are rolled from high quality billets having low carbon and high manganese content. The rolled sections are highly bendable, ductile and easily weldable.

Grade

The sections are rolled strictly as per IS 2062:2006

Sectional Weight Tolerance

The products are rolled strictly in accordance to IS 808:1989

Dimensional Tolerance

Shyam Steel Structurals are rolled in dimensions according to IS 1852: 1985

Weldability

Sections are rolled from fully killed M.S. Billets manufactured in-house. The Carbon Equivalent in the material is as low as 0.2% ensuring high weldability of the products.

Strength

Sections rolled are of high strength ranging from 410 MPA to 600 MPA owing to high manganese content.

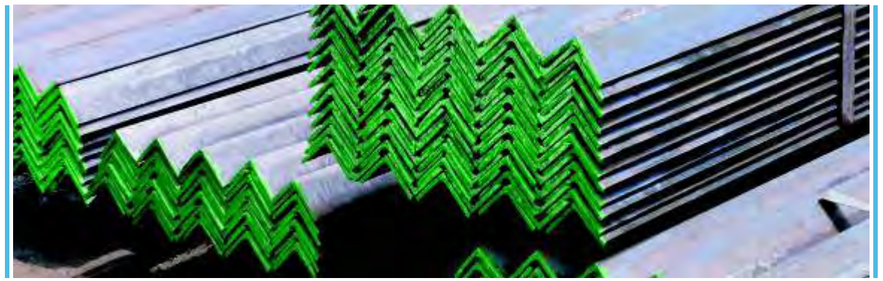
Applications

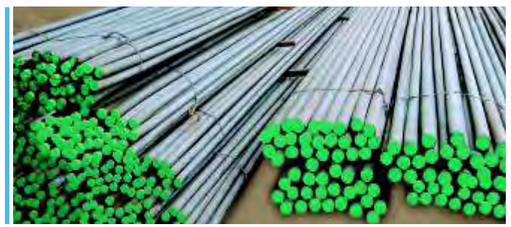
The sections manufactured by Shyam Steel are used in the following:

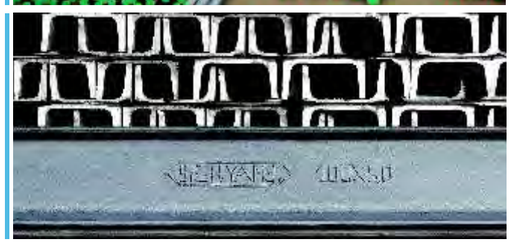
- Precision Engineering Items
- Bright Bars
- Fasteners
- Transmission Towers
- Trusses
- Shades
- Thermal & Hydro Power Projects

Range

M.S. Round Bars	10 mm to 160 mm
M.S. Angles	50x50x6 to 150x150x20
M.S. Channels	75x40 to 300x90
M.S. Beams	125x75 to 300x140
M.S. Flats	20x5 to 200x20







Sectional Weight

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Sectional Weight & Ar value of TMT

Dia. in mm	Nominal value Kg/m	Upper Limit Kg/m	Lower limit Kg/m	Ar value $mm^2./mm$
08	0.395	0.422	0.367	0.96
10	0.617	0.660	0.573	1.20
12	0.888	0.932	0.843	1.80
16	1.58	1.65	1.50	2.40
20	2.47	2.54	2.39	3.40
25	3.85	3.96	3.73	4.25
28	4.83	4.97	4.68	4.76
32	6.31	6.49	6.12	5.44

Sectional Weight

Name of the product	Size	Weight KG/MTR
ANGLES	45 x 45 x 5	3.400
DO	50 x 50 x 5	3.800
DO	50 x 50 x 6	4.500
DO	55 x 55 x 5	4.100
DO	60 x 606	5.400
DO	60 x 60 x 8	7.000
DO	65 x 65 x 6	5.800
DO	65 x 65 x 8	7.700
DO	70 x 70 x 6	6.300
DO	70 x 70 x 8	8.900
DO	75 x 75 x 6	6.800
DO	80 x 80 x 6	7.300
DO	80 x 80 x 8	9.600
DO	90 x 90 x 6	8.200
DO	90 x 90 x 8	10,800
DO	100 x 100 x 6	9.200
DO	100 x 100 x 8	12.100
DO	100 x 100 x 10	14.900
DO	110 x 110 x 8	13.400
DO	110 x 110 x 10	16.500
DO	110 x 110 x 12	19.600
DO	130 x 130 x 8	15.900
DO	130 x 130 x 10	19.700
DO	150 x 150 x 10	22.800
DO	150 x 150 x 12	27.200
M.S .Channels	75 x 40 x 4.8	7.14
DO	100 x 50 x 5	9.56
DO	125 x 65 x 5.3	13.1
DO	150 x 75 x 5.7	16.8
DO	175 x 75 x 6	19.6
DO	200 x 75 x 6.2	22.3

Sectional Weight

Name of the product	Size	Weight KG/MTR
M.S .Channels	250 x 82 x 9	34.2
DO	300 x 90 x 7.8	36.3
DO	400 x 100 x 8.8	50.1
M.S.Joists	116 x 100	23.0
DO	125 x 70 x 5	13.4
DO	150 x 75 x 5	15.0
DO	175 x 85 x 5.8	19.5
DO	200 x 100 x 5.7	25.4
DO	250 x 125 x 6.9	37.3
DO	300 x 140 x 7.7	46.1
M.S. Flat	40 x 6	1.900
DO	40 x 8	2.500
DO	40 x 10	3.100
DO	45 x 6	2.100
DO	45 x 8	2.800
DO	45 x 10	3.500
DO	50 x 6	2.400
DO	50 x 8	3.100
DO	50 x 10	3.900
DO	55 x 6	2.600
DO	55 x 8	3.500
DO	60 x 6	2.800
DO	60 x 8	3.800
DO	60 x 10	4.700
M.S Round	16	1.580
DO	20	2.470
DO	25	3.860
DO	28	4.830
DO	32	6.310
DO	36	7.990
DO	40	9.860
DO	45	12.450
DO	50	15.410
DO	56	19.340
DO	80	39.460
DO	100	61.950
DO	110	74.600
DO	125	96.330
DO	140	120.840
DO	160	157.840
DO	180	199.760
DO	200	246.620