ALL INDIA INDUCTION FURNACES ASSOCIATION

# AIIFA

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## What's Inside





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- Billet and Bars Lifting Rectangular Electromagnets
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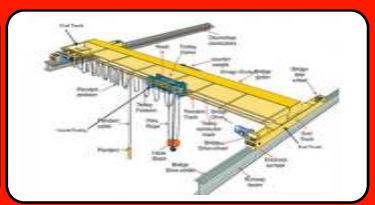
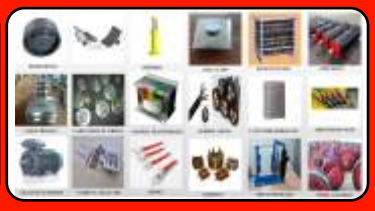
Cable Reeling Drum

- Cable Reeling Drum
- Lining Vibrators
- Electrical Control Panel

EOT Crane

- Single Girder EOT Crane
- Double Girder EOT Crane

Spare Parts & Accessories

- Spare Parts & Accessories of EOT Cranes
- Spare Parts & Accessories For Induction Furnace

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# Low & Medium C–Mn Steel in Structural Applications

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**Introduction:** Steel as the of the most important metal in the world and its products in the modern world is of strategic importance to industrialized nation for economic development. Steel products are viable and cost-effective alternative to any other construction materials which provide the quality requirement for construction activities in every application areas.of strategic importance, At one extreme, construction is referred to as an economic activity that involves the entire construction process from producing raw and manufactured building materials and components, and providing professional services such as design and project management, to executing the physical work on site. Structural steel refers to steel products primarily used in the construction industry. Structural steel is manufactured in many different shapes, including beams, plates, angle and channels. in of various compositions used in fabrication.

Structural steel is arguably one of the most important construction materials due to its strength, versatility, sustainability, availability, and relatively low cost. The ductility of structural steel allows for the creation of various predetermined and customised shapes to satisfy particular construction requirements. That's why structural steel is one of the key applications of steel fabrication. The standards of structural steels in any international standards like AISI/ ASTM, DIN, Gost, JIS, BS, IS (Indian) are fine-tuned to ensure mechanical properties, chemical compositions, methods of manufacture, quality control provisions, and tolerances. in frameworks require conformity to design, material, and execution to ensure the safety and reliability, life of construction projects built with structural steel.

Construction is an economic activity that crosses over all three economic sectors: primary sector that involves the extraction of natural resources; secondary sector that involves the manufacture of building materials and components, and the transformation of these materials into finished buildings; and tertiary sector that involves the provision of consultancy services such as project management, design and structural engineering (Gruneberg, 1997). From this angle of approach, the construction process actually starts long before the physical work on site that transforms materials and design into the complete buildings, structures and facilities.

## Structural Steel and Area wise Application & its Broad Classification:

Structural steel is a category of steel used for making construction materials in a variety of shapes commonly used resource in the construction industry. These are mainly shaped to build bridges, ships, buildings as well as off-shore rigs and pipelines. It adapts to several various functions and activities. It is the most preferred steel over any metal for architects because of its numerous advantages. The manufacturers use different structural steel sections such as steel plates, light steel sections,

composite panel cladding systems, etc., for various construction projects for reasons- .

A. Structural Steel enables the architects to experiment and innovate continuously at the same time, modern architects will go for it over other building materials to construct innovative strong projects. The high flexibility of structural steels allows architects to convert them into any shape and size ensuring architects to introduce unique curves to the project's having beautiful structural design and effect keeping its inherent strength intact.

B. Structural steel is 100% recyclable resource, ability to be recycled repeatedly as multy-cycled without loss of quality and quantity..

C. The ductility property in structural steels permits a structure to survive a severe earthquake loading providing a warning signal before an actual failure and can hold against all kinds of external pressures such as earthquakes, storms, and hurricanes. It is used to strengthen the existing material and to check concrete's low tensile strength and flexibility. These properties make it the most preferred metal for building skyscrapers, residential buildings, bridges, office buildings, etc.

**Broad Classification:** Structural steels are available in different grades and forms as Carbon & Alloy Steel. Carbon steel mainly alloy of carbon and manganese, having highest usage in different applications. This grade may be classified into four major categories. It is an alloy of varying percentage of carbon and manganese with presence of low aluminum, sulphur and phosphorous (0.035- 0.050). carbon content from about 0.05 up to 2.1 percent by weight.. However carbon steel is classified as - .

1. **Low-carbon steel.** 0.05 to 0.15% carbon..Low-carbon steels, often termed as mild steel, contain up to 0.30% carbon. A majority of this class of steel is flat-rolled products like sheet or strip; usually they are in a cold-rolled and annealed condition. These steels have high formability as they contain very low carbon, usually less than 0.10% C, with up to 0.4% Mn.

**Low carbon steel forged part**

2. **Medium-carbon steel.** Approximately 0.3–0.5% carbon content. Medium-carbon steels are similar to low-carbon steels except that they contain carbon from 0.30% to 0.60% and manganese from 0.60% to 1.65%. Increasing the carbon content to approximately 0.5% with an accompanying increase in manganese allows medium-carbon steels to be used in the quenched and tempered condition.

**Medium Carbon Steel Foged Component**

3. **High-carbon steel.** Approximately 0.6 to 1.0% carbon steel is material of choice for seeking a strong and long lasting product for their application. It is an alloy made from iron combined with other elements including Carbon, Manganese, Silicon, Phosphorous and Sulfur.

**Figure 1 High Carbon Steel Wall Nails**

The properties of this type of steel makes it ideal for several uses due to its strength and durability; in particular tool applications such as automotive components and kitchen knives. Throughout this blog post we will explore the composition of high-carbon steel along with the most common applications that make use of this specialized alloy. In addition, we'll discuss how high-carbon steel works best in certain conditions while also providing some tips on how to maintain and work with materials that are equipped with high-carbon steels

4. **Ultra-high-carbon steel.** Approximately 1.25–2.0% carbon content. Ultrahigh-carbon steels (UHCSs) are low-alloyed plain carbon steels. These steels have remarkable structural properties when processed to achieve fine ferrite grains with fine spheroidized carbides. They can be made superplastic at intermediate temperatures. Ultra high carbon steel is brittle, very hard, and can't be cold-worked. It's used to make extremely hard components like blades, cutting tools and large machine parts, hot water radiators, industrial castings and metal lamp posts

**Ultar High Carbon Steel Knife**

**5. High-strength, low-alloy (HSLA) steels** (often called micro-alloy steels): They are used in cars, trucks, cranes, bridges, roller coasters and other structures that are designed to handle large amounts of stress or need a good strength-to-weight ratio. HSLA steel cross-sections and structures are usually 20 to 30% lighter than a carbon steel with the same strength.

| Steel | Chemical composition (wt. (%)) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | C | Mn | Nb | Mo | Tl | N | P | S | Si | Al |
| **X80** | 0.060 | 1.650 | 0.034 | 0.240 | 0.012 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 |
| **HSLA65** | 0.062 | 1.240 | 0.063 | 0.008 | 0.002 | 0.007 | 0.007 | 0.004 | 0.051 | 0.040 |
| **HSLA 90** | 0.050 | 1.650 | 0.071 | 0.196 | 0.021 | 0.000 | 0.010 | 0.004 | 0.025 | 0.027 |
| **Nb steel** | 0.060 | 1.200 | 0.062 | 0.000 | 0.000 | 0.008 | 0.000 | 0.007 | 0.290 | 0.035 |
| **Nb-Mo steel** | 0.050 | 1.880 | 0.049 | 0.490 | 0.000 | 0.004 | 0.005 | 0.007 | 0.040 | 0.050 |
| **Dp600** | 0.060 | 1.860 | 0.000 | 0.155 | 0.011 | 0.007 | 0.015 | 0.004 | 0.077 | 0.043 |

**Chemical Composition of few Micro-Alloy Steel Grades**

**HSLA Forged Steel Component**

Micro-alloy (MA) or High Strength Low Alloy (HSLA) steels constitute an important category of steels estimated to be around 12% of total world steel production. They are used in every major steel market sector in many parts of the world and their development has played an important role in the expansion of certain key industries such as oil and gas extraction, construction, and transportation.

Since, Micro-alloy steel i.e. High strength low alloy steel have replaced many steel products in construction, manufacturing & engineering industries, among the HSLA group, grade to be selected properly i.e performance of the material that helps engineers in

determining the choice of HSLA steel for their specific project to determine the amount of energy can absorb energy in different construction at varying temperatures.lly in situations where the bridge may need to endure cold atmospheric conditions. Effect of different composition help engineers and designers for construction of structures any project can be lined up.. Present consumption of this popular grade in the world is about 12-15% as this grade has replaced many tradional steel grades based on cost, property and ease of manufacturing.

6. **Heat-treated carbon steels,** In this process, properties are controlled by heating and cooling products to acieve the desired levels of property, process includes normalizing, annealing, quenching, tempering, and surface hardening.Heat treating is performed to enhance the properties of the steel, as the hardness of the material increases when applying successive heat treatments.

7. **Heat-treated alloy steels** are used when homogenize cast metal alloys are required for construction or manufacture for improving product hot workability, to soften metals prior to, and during hot and cold processing operations, or to alter their microstructure in such a way as to achieve the desired mechanical properties.

**Hardened & Tempered En24 Forged Machined Rolls**

## Govt. Initiatives in Enhancing Production & Consumption :

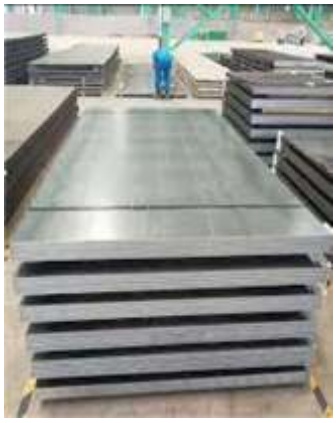
**Construction:** Consumption of C-Mn and HSLA steels currently accounts for largest share over 65% and the balance is accounted for by the sectors such as engineering, packaging and automotive which are also displaying admirable increase in steel application year after year. Central Government is continuously interacting with various state governments to ease the process of implementation of various projects for the benefit of the country laying major emphasis on development of infrastructure across the country with a self-reliant India.

**Structural Application:** C-Mn and also HSLA steels ares used to produce the steel channels, plates and support beams found in residential, commercial, and industrial buildings such as homes, hospitals, stadiums, and bridges.

Structural steel is also used to construct industrial spaces such as warehouses, bridges, factories, and buildings. These require structural steel to form steel frames, columns, bars, plates, and girders, among others.

Support Beam

Channel



Plate

TMT Bat

**C-Mn Steel Products for Structural Applications**

Ship Building

Automobile

Material Handling

**C-Mn & HSLA Steel are used in Ship Building, Automotve, Material Handling Equip.**

Indian construction industry held the largest volume share of nearly 42.0% in 2022 and this trend is anticipated to continue in future also. Low carbon steel offers excellent forming and welding capabilities along with advantages such as no cracks on bending, flexibility, ductility, plasticity, and endurance in case of calamities like earthquakes, which make it a preferable choice in the construction industry. Carbon steel's strength in calamity situations is its major benefit, which prevents the building from collapsing and saving its occupants.

Carbon steel finds application (shown above) in shipbuilding, construction, automotive, and other applications such as energy, machinery, appliances, and material handling.

The usage of steel in shipbuilding is owing to its mechanical properties and low cost. Carbon steel is of vital importance in the ship-building industry, however, the decline in industry growth along with the preference towards substitutes such as aluminum alloys is anticipated to hinder product consumption in the shipbuilding sector.

Construction industry is the largest consumer, accounting for approximately 50% of total world steel consumption. Transport sector (cars, trucks, aviation, shipbuilding, and rail) is the second. The machinery industry and metal products industry each consume around 14% of the world's steel. Most of the world's greatest architectural wonders have been built with steel, whether structural, carbon, or rebar in addition to all of the various types of steel available for building construction. Most importantly, the use of steel assures greater environmental friendliness than other types of building, and for this reason alone, it is preferred.

**Mining:** In the mining industry, structural steel components are used for a variety of mine site equipment and infra-structural needs. This includes the mines' structural elements, such as mining screens, the fluidized bed builders, and even the buildings, such as workshops and offices.

The requirements for steel used in mining applications are not only unique but also challenging, but in the tough conditions of a mine, steel is a perfectly reliable material that can perform as needed. However, most of the mining infrastructure is created using wear resistant steel, structural steel, stainless steel, and high strength steel. Top hammers, tools, demolition equipment, drill rigs, mining support equipment, grinding media, mining screens, fluidized bed boilers, pumps, heat exchangers, as well as heavy mining machinery such as mass excavators, bulldozers, shovels, and crushers all rely on the material properties of steel. In addition, steel also has significant cost advantages compared with other materials. High Carbon High Manganese wear resisting steel is used in manufacturing parts in specific areas..

**Energy:** The energy sector uses structural steel in producing wind, electric, and nuclear power, and natural gas transmission towers, wind turbines, pipelines, oil and gas wells using components of structural steel.

Some of the steel types used in construction are – Rebar steel made from carbon steel having edges for mechanical fastening , often known as reinforcing or fortifying steel, is used as a strain device in reinforced concrete or masonry structures. It holds the solid under pressure and is available in various grades and composition with different yield strengths, necessary elasticity, and elongation percentage parameters. Rebar steel offers durability and aesthetic appeal, as well as local resistance and stiffness that extend across a large area where other types of steel aren't often prepared. This type of steel is used to make structural steel shapes because it is made from a detailed cross-section while adhering to strict mechanical and chemical composition norms.

Different countries have different requirements for standard structural steel. Structural steel is ductile, sturdy, and durable, and it can be molded into almost any shape depending on the nature of construction; it may be built almost immediately after arriving at the construction site. This type of structural steel is fire-resistant but fire protection should be supplied if it becomes overheated to the degree that it begins to lose strength. Corrosion must be avoided when employing structural steel, although towering buildings can withstand various disasters when constructed with structural steel.

Mild steel commonly known as MS is the most prevalent type of steel used in building construction. It's incalculably strong and long-lasting, and it makes a solid foundation. Mild steel is very useful in buildings because of its strength, and it has proven to be beneficial. It does not break when bent and is extremely flexible and malleable with high plasticity, and can withstand natural disasters such as earthquakes without generating cracks in the steel. Mild steel's most useful feature

in structural applications and seldom prone to collapsing or destruction. It can resist any disaster and is sturdy enough not to fracture.

There are two yield points in this type of steel. Low carbon steel is easier to work with since it may be handled by two yield points, which are slightly higher than the second, lower yield point. Plain-carbon steel has better strength than any other steel due to its weldability. On the other hand, fire protection is critical in a steel structure and carefully considered. Except for it, there are no difficulties with the steel structure.

**Process Metallurgy:** Construction grade carbon steel is melted in EAF/IF in mini steel plants either from ingot on concast route which are further rolled and heat treated as and when necessary. Steel is un-killed only by ferromanganese which acts as a weak deoxidizer. Because the remained FeO in the molten steel can generate CO with C, there are a lot of foams in the process during ingot casting, like boil, known as rimming action .The rate of finished products is high and the cost is low compared to even high strength low alloy steels..

The chief reason for desired steel product from the steel of properly rimmed character is that such products have excellent surface quality, as well as certain ancillary benefits usually associated with the surface regions of rimmed steels. There are definite limits to the content of carbon or manganese (or both) which should be maintained without adversely affecting the rimming action and without likewise impairing the good surface quality achieved by such action.

In case of higher carbon as up in the range = 0.2 are particularly suitable for many structural purposes, as sheets or bars in hot rolled as well as cold rolled state, yet such products cannot be made satisfactorily as rimmed steel because of the high carbon content. Hence, it has been impossible to obtain in a convenient, economical manner, the good surface condition of a rimmed product, at the indicated carbon levels, Likewise with or without the higher range of carbon, the manganese content of rimmed steels has necessarily been limited.

**Actions during teeming for better quality ingot in C-Mn steel:** If Mn in this grade is toward higher side in the composition well above 0.6% which is particularly suitable for commercial products like stamping and drawing grades (e.g. cold rolled products), such grades cannot be made as rimmed steels, or more particularly, cannot achieve the highly desirable surface characteristics of rimmed steel, basically suitable only for deep drawing purposes when cold rolled. During liquid steel teeming in mold, when poured to nearly fill, teeming is interrupted for several minutes to permit rimming action while a skin of rimmed steel solidifies against the mold wall, and then again teeming is continued to fill the mold with aluminum introduced into the falling stream of molten steel so that the ultimate ingot consists of a core of aluminum killed steel having a skin of rimmed steel.

From such ingot, rolled products are having basically the properties (in the core) of killed steel, with a rimmed surface by addition of other elements, such as columbium, in very limited quantity for special purpose along with the aluminum. This provides a new and effective method of producing steel products having superior properties of strength, toughness and the like as economically achieved by a relatively high content of carbon or manganese, or both (such being a higher proportion of one or both elements than is consonant with naturally good rimming action), while providing on the principal surface of the product an integral skin of rimmed steel having the superior surface quality of such rimmed steel.

| | | |
|---|---|---|
|  |  |  |
| **Bridge** | **Coal Mine** | **Power Plant** |
|  |  |  |
| **Structure** | **Chemical Pipe Line** | **Power Plant** |

**Above Photographs of Structural Steel Applications (Bridge, Coal Mine, Power Plant, Factory Shed, Chemical & Gas Pipe line)**

This essentially consists in first making a base melt of rimming steel, e.g. containing up to 0.12% carbon and up to 0.6% manganese, with no deoxidizing elements sufficient to interfere significantly with rimming melt is teemed into each ingot mold, to the point of 80% to 95% full, whereupon pouring is interrupted while effervescent rimming action proceeds and a skin or shell of steel solidifies next to the mold wall. After a waiting period of 2 to 8 minutes, even up to 10 minutes although 5 or 6 minutes usually suffices, teeming of the same base melt into the mold is resumed while injecting into the stream of metal sufficient amounts of carbon or manganese, or both, for instance as one-fourth inch size particles of pure carbon or graphite or manganese or ferromanganese, to provide a desired content of C or Mn in the ingot core.

Ultimately solidified ingot constitutes a core of the desired steel surrounded by a skin of steel which is essentially pure ferrite, i.e. low-carbon, low-manganese steel in rimmed state, having a clear surface of superior quality. If desired, the core body may be aluminum killed, i.e. by adding sufficient aluminum, for instance up to 0.2% during the interval of back-filling, which means the interval of the completion of teeming into the ingot mold; aluminum can be added in even larger amounts. Other elements that can be so introduced include silicon, as for certain strengthening function and also deoxidation.

If the body of the steel is insufficiently deoxidized to be fully killed and thus, although not of rimming character, may be found to exhibit some aging, addition of vanadium may obviate this problem, or alternatively, boron. The core, that contains manganese in the range above 0.6%, i.e. up to 1.75%, with consequent strength advantages of a relatively high manganese steel.

**Conclusion:** Generally, there are different levels for application of constructional steel in the industry which connected to economic activity that involves the entire construction process from producing raw material to manufacture constructional steel for steel stuctural products, components, and providing professional services designing production and execution.

In India, the emerging growth of steel structure usage has seen a major spike in recent times like developed countries. The infrastructural scene is completely different than it used to be in previous times due to the constant rise of multinational companies in the country. New world-class techniques and tools are also adapted while implementing related work as reinforcing structures, columns, cladding, structure strengthening and many more. An estimation by industrial experts or pundits, the construction industry of India is expected to boast the third-largest construction market on a global platform by the end of 2025.

The constructional steel manufacturing and industrial usages are conceived as an economic activity that focuses only on the last stage on the production stage.. From this perspective, all services such as project management, planning, design as well as the offsite manufacture and supply of constructional steel products in different varieties for architectural, engineering activities, manufacture of ship, aero-space, automobile, heavy industries. are growing. on a global basis, it's been established that constructional grade steel is of the primary and most important steel-using industries which accounts for more than 50% of the world steel demand.

# Importance of Standard & Specification in Steel Industry

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**Prabhakar Mishra**
*Sr. Exe. Director, AIIFA, ND*

**April continued .....**

A clear definition of material properties is essential to all producer and users throughout the supply chain. Steel producers use standards to develop the correct formulations, process parameters, and determine dimensional, tolerance, defect free product for production at their own pants. Management, Metallurgist, Engineers, Shop floor personnel even Contract Labors should use standards them to select the best-suited steel products for need of customers or any project, both in terms of its manufacturability, fabricatibility and its end use. People directly handling the production should be properly trained on the subject.

A few of the many characteristics defined in a steel standard include though these can vary widely between different types of steels and alloys. Even within one category, they can vary by the grade of material, Compressive and Tensile strength, Ductility, Hardness, Toughness, Fatigue Strength, and Corrosion Resistance. Over the years, with the increasing competition of the marketplace, the distinction between manufacturing and service industries is getting blurred. The core, manufactured products today are so entwined with services, that they have become indistinguishable. Moreover, these services are expected by the customer as an integral part of the product. Slowly all business is tending to be service-oriented, aimed at satisfying customer needs.

**Challenges Towards Delighting Customers:** The Indian steel industry has been liberalized, after decades of protection and fierce competition. Capacities are being added at a furious pace, newer technologies are being introduced and cheaper imports are being dumped. In such a scenario, the answer to gaining competitive advantage lies in providing superior value to the customer, by providing customer service with the product at a lower delivery cost. Using customer service to retain and acquire customers providing a new strategic advantage for steel makers. The key issues, and possibilities of making progress, strategy for achieving strategic advantage through customer service. The concept can be extrapolated for any developing economy dealing the competition.

**Priorities in Steel business:** In an era where markets are fragmenting into narrower customer segments, product life cycles are shortening, information technologies are blurring traditional demarcation lines between markets and organizations, increased customers' expectations where supply is exceeding the demand. The , the rate of change in the market has clearly outstripped the pace of change in Indian mini steel plant This is true for the steel market in India today. The threat is accentuated by the increase in capacity which is faster than the demand. In such a competitive scenario only those companies, which are able to fully the expectations of its customers would only survive.

**Competitive superiority:** This would be revealed in the market as some combination of superior customer value with quality and lowest delivery cost. These essential generic positional

advantages would be derived from augmenting the product to the maximum, especially in the area of service. To that extent it would need an integrated approach to the fundamental issue of knowing the customers better, and serving them to their satisfaction level. Thus, in today's highly competitive business scenario only those companies will reign supreme which are better (through superior quality of product and services),faster (by being able to sense and satisfy shifting customer requirements faster than competitors) and closer (with the creation of durable relationships) .

The service is the object of marketing, i.e. the company is selling the service as the core of its marketing offer". A study conducted by E.J. Nouri reported in Sales Management (2 April, 1965) showed that industrial buyers ranked patronage in the following order of importance:(1) quality;(2) technical assistance;(3) service;(4) price. Voice of the Indian steel customers: are rising expectations. It is interesting to note that the Indian steel customers, after decades of bearing the pressures of a sellers market, have started to voice their expectations explicitly as steel is not just a commodity; it has speci?c attributes that have to be met day after day..

It is observed from analysis by different experts show that the expectation of customers are changing and are valuing service as an essential part of the product like .Correct quantity as needed by the customers ( to maintain optimum inventory). Timely delivery. Supply of product as per need. More favourable commercial terms. More positive orientation and a problem solving predisposition. Simpli?ed procedures. Competitive price. An ef?cient post sales service including settlement of complaints. Organized customer visits. Enhancing relationship through better service and more co-ordination with plants. Exploring newer applications of existing products. Introducing newer need-based products. Strengthening bonds further between the customers and the producers.

**Conclusion:** Steel making, Shaping & Treating industries use the properties outlined in standards to assess the suitability of the material for subsequent processing in one or more metalworking operations, fabrication, or machining applied during a component/ part's manufacture. Some processes may require the steel products to withstand high compressive forces, while others, such as in the case of forming, require product with high tensile strength that can be easily stretched. In absence of relevant information from downstream processing or manufacturing units, problems, often, come, but in all the cases, steel making units are blamed for poor and sub-standard quality products melting.

**Steel producers** must also select base materials jointly with customers on end-use customer requirements. Many industries, such as aerospace and automotive, specify that a particular standard grade metal be used in the construction of a component, and manufacturers rely on the ability to easily procure materials that are in compliance with those requirements. The clear-cut and comprehensive definition of a metal grade also removes the risk of errors in production due to lack of complete specifications.

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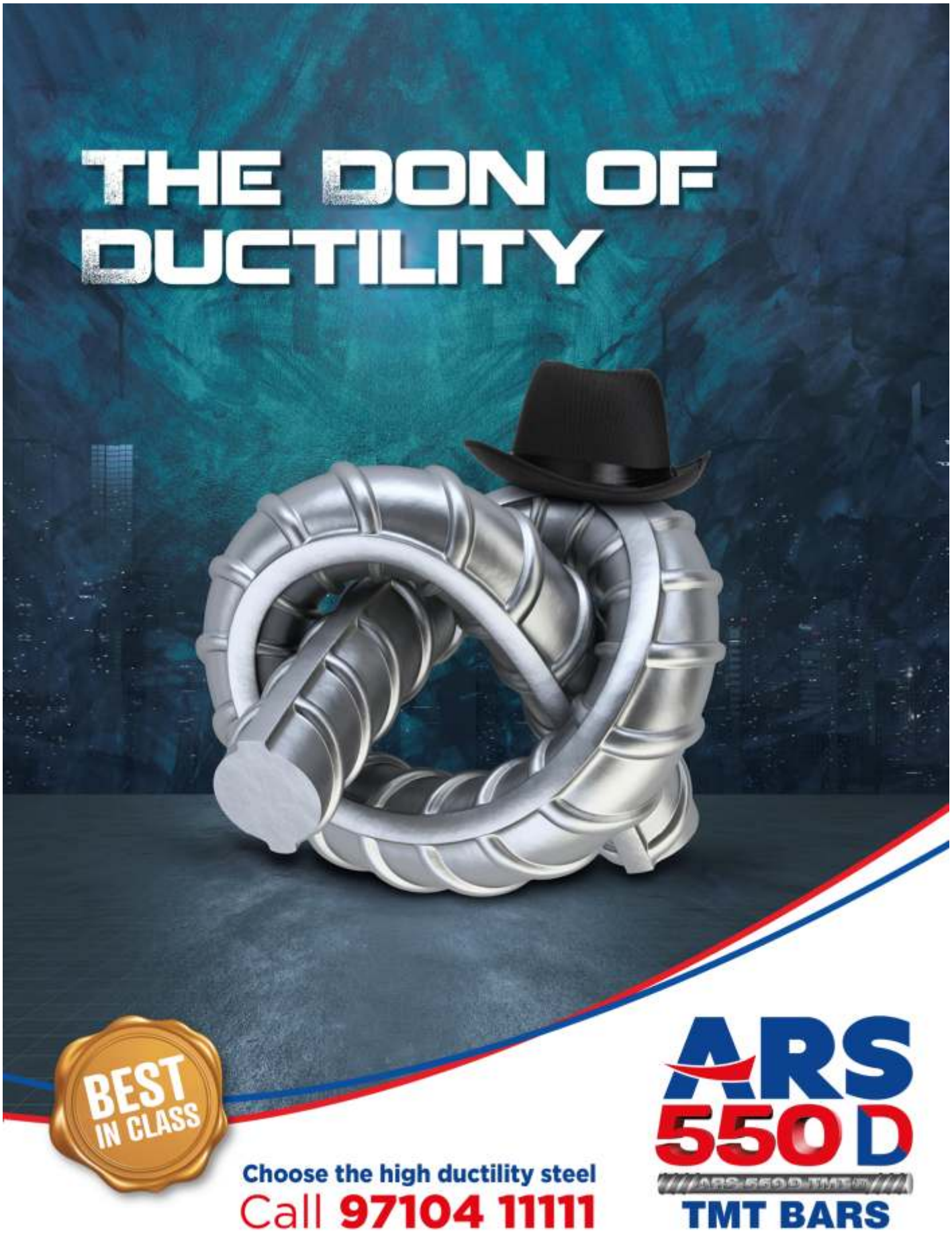
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## 28th - 29th JULY 2023

Pragati Maidan, New Delhi, India

## A Sneak Preview

- Support from all relevant **Ministries, Trade Associations of Steel** and Allied industries
- Expected Presence of **200+ Leading Exhibitors**
- A high-level **35th National Conference** on "Decarbonising the Steel Sector in India: An era of moving towards greener path through Circular economy"
- Expected footfall of **5000+** serious trade buyers
- Various **New Launches** by exhibitors

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