

Steel in Construction: Development of Codes and Standards



Sh. Manas Mohon Ghosh
Institute for Steel
Development and Growth
Kolkata



Economy and Consumption of Steel

Infrastructure sector is a key driver for the Indian economy. The sector is highly responsible for propelling India's overall development and enjoys intense focus from Government for initiating policies that would ensure time-bound creation of world class infrastructure in the country.

Infrastructure sector includes Power, Bridges, Ports, Airports, Railways, Irrigation, Water Supply, Sanitation, Roads, and Urban Infrastructure Development. It drives the growth of the allied sectors like rural development, job creation, logistics, etc.

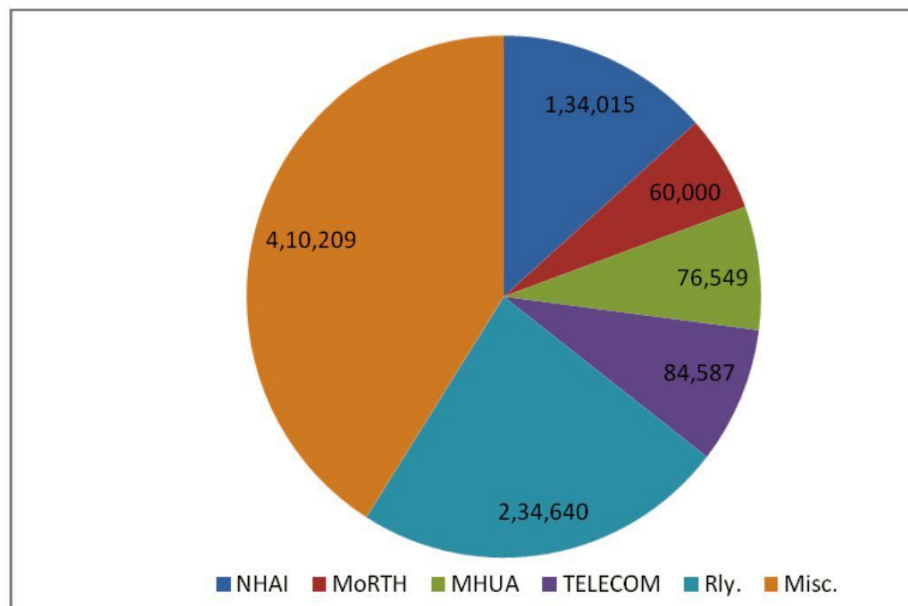
India's aim is to reach a US\$ 5 trillion economy by 2025. Infrastructural development is a major booster. The government has launched the National Infrastructure Pipeline (NIP) combined with other initiatives such as 'Make in India' and the Production-Linked Incentives (PLI) scheme to augment the growth of infrastructure sector. Prime Minister has a vision to make India a developed nation by 2047. There is a target of INR 110 trillion in NIP alone. Centre's Capex is to reach INR 10 trillion in FY 2024.

Historically, more than 80% of the country's infrastructure spending has gone toward funding for transportation, electricity, and water & irrigation.

Some of the recent government initiatives and investments in the infrastructure sector are as follows:

- **In Union Budget 2022-23:**
 - The government has given a massive push to the infrastructure sector by allocating Rs.10 lakh crore (US\$ 130.57 billion) to enhance the infrastructure sector.
 - The government allocated Rs.134,015 crore (US\$ 17.24 billion) to National Highways Authority of India (NHAI).
 - The government announced an outlay of Rs.60,000 crore (US\$ 7.72 billion) for the Ministry of Road Transport and Highways (MoRTH).
 - The government announced Rs.76,549 crore (US\$ 9.85 billion) to the Ministry of Housing and Urban Affairs (MoHUA).

- o The government allocated Rs.84,587 crore (US\$ 10.87 billion) to the Department of Telecommunications to create and augment telecom infrastructure in the country.
- o The total revenue expenditure by Railways is projected to be Rs.234,640 crore (US\$ 30.48 billion).
- o 100 PM-GatiShakti Cargo Terminals for multimodal logistics facilities will be developed over next three years.
- o Focus was on the PM GatiShakti - National Master Plan for multimodal connectivity to economic zones. Everything, from roads to trains, from aviation to agriculture, as well as many ministries and departments, will be integrated under the PM GatiShakti National Master Plan.



Source: Govt of India Portal

Role of Steel

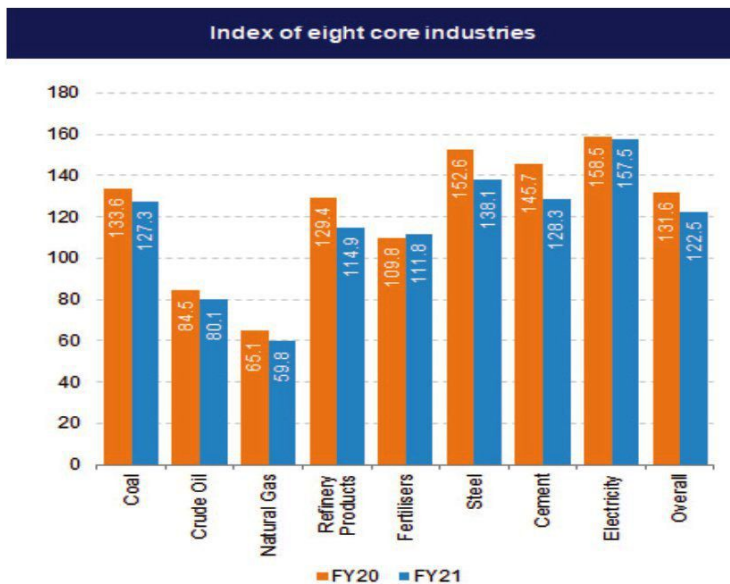
Here comes the importance of steel and its consumption pattern.

Steel and Cement ratio, as it stands out in India is approximately 0.3. In many developed countries

the same is as high as 1.5. So, apparently there remain a space where steel may find its use. That leaves ample room for promotion to increase the consumption of steel in infrastructure in the country.

The bar chart delivers a comparative position of Steel sector vis-a-vis all other seven core industry in the manufacturing side.

Consumption / Demand in Building and Construction (in Million Tons)



Source: Govt of India Portal

The bar chart is impressive and shows Steel industry's impact on Indian Economic scenario.

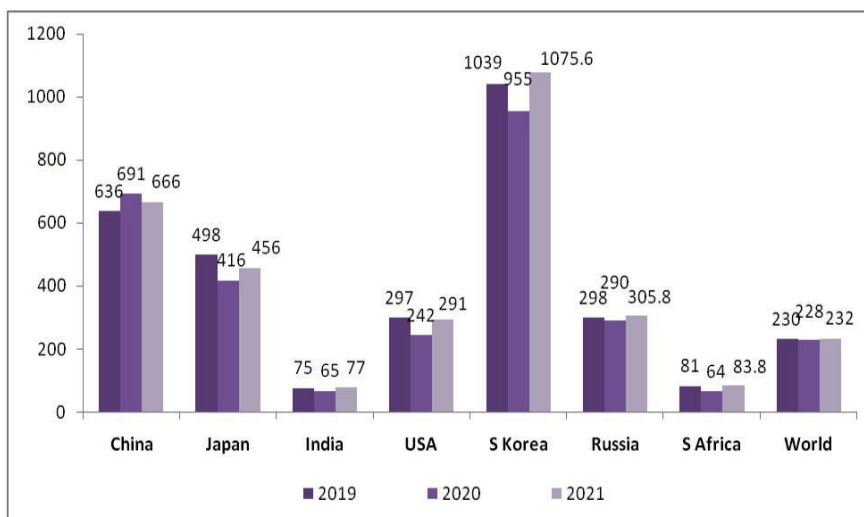
of actual consumption may be considered the reference point of economic indices of this sector.

Though the per capita of consumption of steel in the country is very low in comparison to world average, the recent plans of Infrastructure development keep a huge scope of use of steel. However, the per capita consumption in such a populous state may an aberration; the figures

Consumption in the rural sector is abysmally low, 21kgs in 2022 as per the data available from JPC. However, the same in urban sector has shown signs of development. The overall consumption is around 77.2 kgs. in 2022.

Below is the Country-wise per capita consumption of crude steel – year-wise

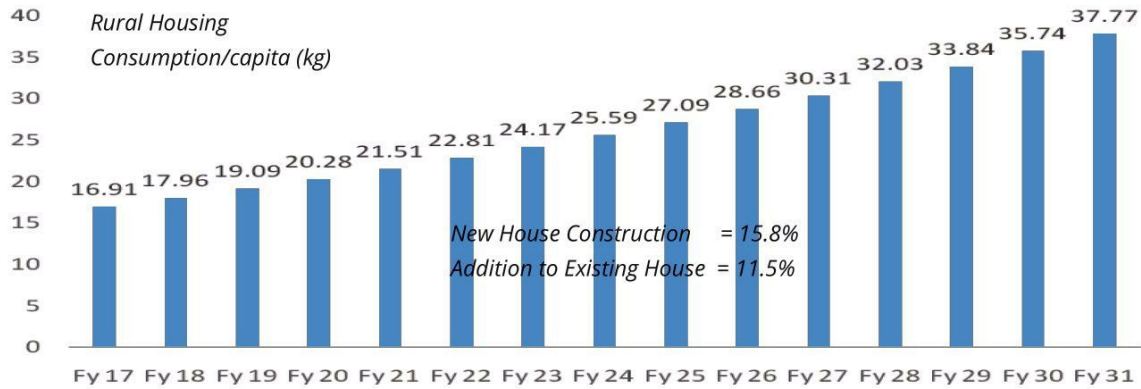
Per Capita Consumption of Steel- in kgs- 2019, 2020, 2021



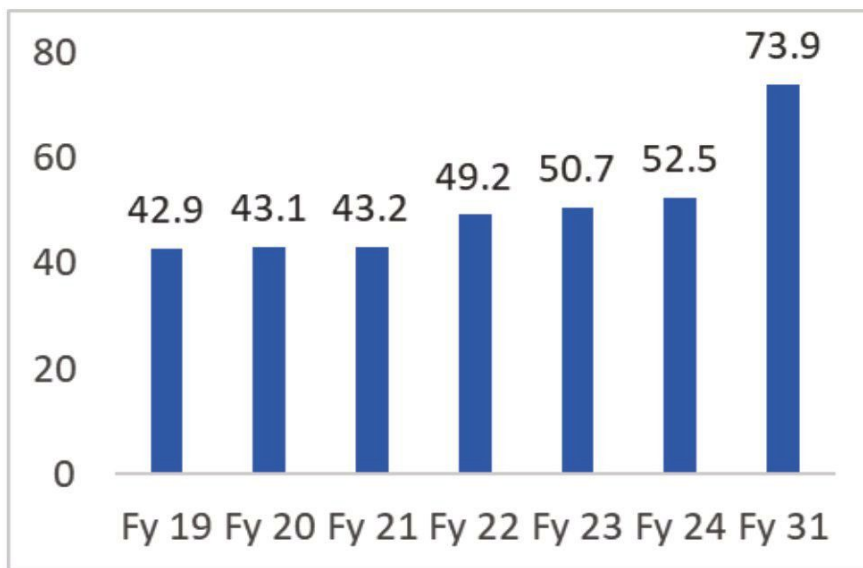
The National Steel Policy has set a target of 130 kgs per capita consumption by 2030.

The per capita consumption of steel for rural housing has been projected as below:

Rural Housing – Consumption per capita



Source: JPC End Use Segment-wise Steel Demand, FY19 Study by CRISIL



Source: JPC Steel Demand in Rural Areas, FY 19 Study by IMRB

Study of these graphs leads to the assumption that the consumption of steel in the infrastructure has a ample space for high growth. The Government spending via central schemes like Bharatmala, Sagarmala, Railway (Metro and Dedicated Freight Corridor (DFC)), Civil Aviation, Jal Jeevan to name a few are the boosters and avenues for spending and development.

However, consumption of Steel in India is not taking off in a desired pace. Some of the factors are – lack of awareness among the deciding authorities about the long-term benefit of Steel, lack of focus on Steel in Govt Tenders, lack of thrust on Steel vis-a-vis other construction materials. In addition, in terms of structural design and ease of use, Bureau of Indian Standards (BIS) needs to address adequately in simplistic fashion (without creating ambiguity) explanations which will make use of Steel easy among architects and Engineers.

Preparedness of Codes developed under Bureau of Indian Standards (BIS), Indian Road Congress (IRC)

With this punch in demand boosting, actual implementation will be a combination of actual output of all stake holders, both from supply side and demand side. In between are the codal provisions which also play a silent but important conduit for smoothening this developmental process. Its role and importance can be gauged when a technically qualified product is served.

The importance of codes is well defined in BIS document itself, reproduced here which is as follows:

- Codes and Standards ensure the safety, Quality and reliability of products and services. They facilitate trade and protect our health and the health of our environment.
- It serves various purposes for businesses, for customers, for Government.

A review and the status of some handpicked codes and standards have been made which basically have influenced the more use of steel.

Revolutionary Revisions

Codes	Title	Earlier Revised	Last Revised
IS 800	General construction in steel – Code of practice (third revision)	1984	2007
IS 875 Part 3	Code Of Practice Design Loads (Other than Earthquake) for Buildings and Structures- Code of Practice: Wind Loads	1987	2015
IS 1893 Part 1	Criteria for Earthquake Resistant Design of Structures: General Provisions and Buildings	2002	2016
IS 808	Hot Rolled Steel Beams, Columns, Channels, and Angle Sections- Dimensions and Properties	1989	2021
IS 2062	Hot Rolled Medium and High Tensile Structural Steel - Specification	2006	2011
IS 1786	Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement (amended)	2008	2019
IS 11384	Code of Practice for Composite Construction in Structural Steel and Concrete	1984	2022
IRC 6	Standard Specifications and Code of Practice For Road Bridges: Loads and Stresses	2016	2017
NBC	National Building Code	2008	2016
IRC 22	Standard Specifications and Code of Practice For Road Bridges: Steel Concrete Composite Construction	2010	2015

The BIS code: IS 800

This code has been a major revolution in structural steel design since 2007. It transformed the theory of designing from Working Stress Method (WSM) to a much-developed Limit State Method (LSM). This concept was a paradigm shift and Structural Design Engineers had to unlearn and then relearn the concept. It brought rationale in the designing system. In view of the

developments and production of new varieties of medium and high tensile structural steel in the country, the scope and the standard of the code have been modified permitting the use of another variety of structural steel provided the relevant provisions of the standards are satisfied. Certain physical properties like plastic moment of inertia, torsional cross section properties have been added which are required in Limit State method of calculation.

The BIS code: IS 801

This code is undergoing revision currently. Incidentally, it was revised last 45 years back and has been due for an update long time back. The code is Use of Cold Formed Light Gauge Steel Structural Members In General Building Construction. Here also the concept of designing is being changed, which again will be a huge deviation from the earlier theory. The pre-Engineered Building (PEB) sector using cold formed steel will be highly benefited with this development.

The BIS code: IS 875 Part 3

This code which provides the guidelines for quantifying loads generated from the effects of wind on structures has been revised in 2015 has considered all the developments like identifying and factoring cyclone prone areas, revising Terrain Category, incorporating Terrain and Height Multiplier, revising Gust Factor method to name a few. The Wind Map of India was also updated.

The BIS code: IS 1893 Part 1

This code quantifies external load developed due to tectonic movement of the earth's crust leading to earthquake which affects structure. Experiences from certain major earthquakes and the data generated thereafter have been included in the code. The values of Design spectra were modified, bases of various load combinations were streamlined, temporary structures were brought in its fold, importance factors were modified, provisions of Torsion was simplified. The earthquake map of India was revised, Zone 1 was eliminated.

The Indian Road Congress (IRC) code: IRC 6

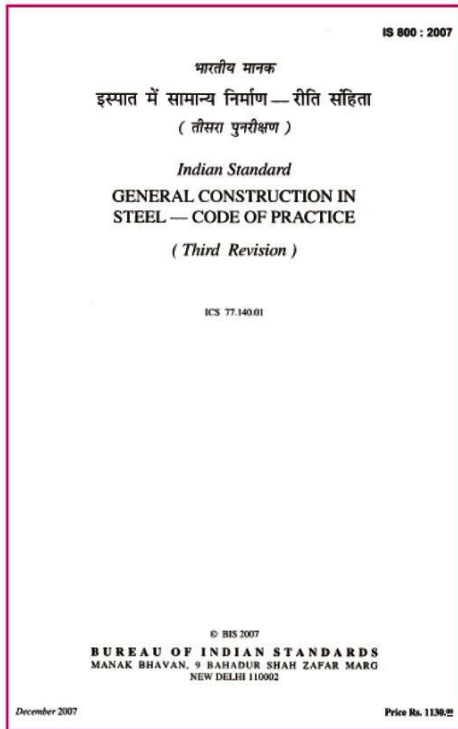
This code dealing with quantification of external loads and stresses developed on Bridges due to vehicular movements has incorporated all the new developments of vehicles and its loading aspects. This is again a revolutionary revision.

Some of the codes of great importance, basically for designing has been reviewed and is been discussed here.

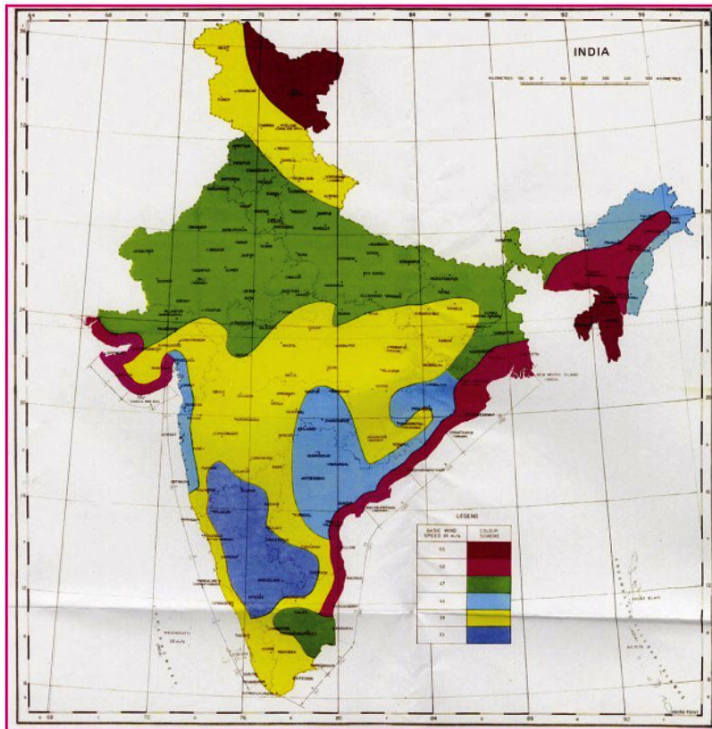
Selected codes under consideration for Revision/ Reaffirmation

BIS	Earlier Revised	Title	FOR	Last Revised
801	1975	Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members In General Building Construction	*****	
802	1978	Code of practice for use of structural steel in overhead transmission line towers: Part 2 Fabrication, galvanizing: Inspection and packing	*****	*****
803	1976	Code of Practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks (first revision)		*****
804	1973	Specification for rectangular pressed steel tanks (first revision)		*****
805	1968	Code of practice for use of steel in gravity water tanks	*****	
806	1968	Code of practice for use of steel tubes in general building construction (first revision)	*****	*****
2314	1986	Specification for steel sheet piling sections (first revision)		*****
2713	1980	Specification for tubular steel poles for overhead power lines (second revision)	*****	*****
2750	1964	Specification For Steel Scaffolding	*****	
4000	1992	High strength bolts in steel structures – Code of practice (first revision)		*****

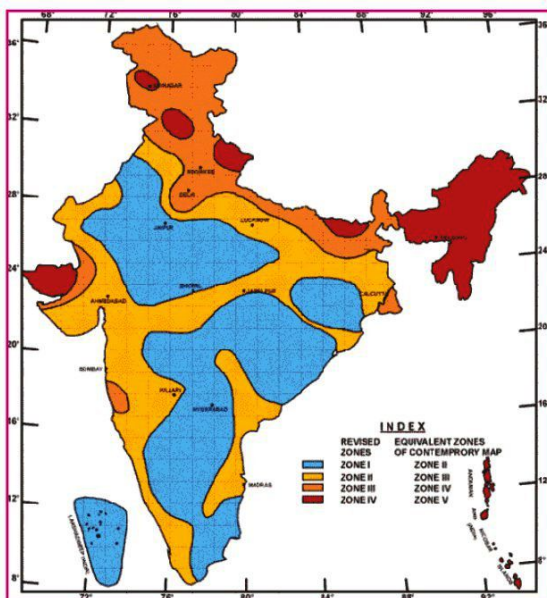
BIS	Earlier Revised	Title	FOR	Last Revised
4014	1967	Code of Practice For Steel Tubular Scaffolding	*****	
6533	1989	Design and construction of steel chimney - Code of practice	*****	*****
9178	1979	Criteria For Design of Steel Bins For Storage of Bulk Materials	*****	



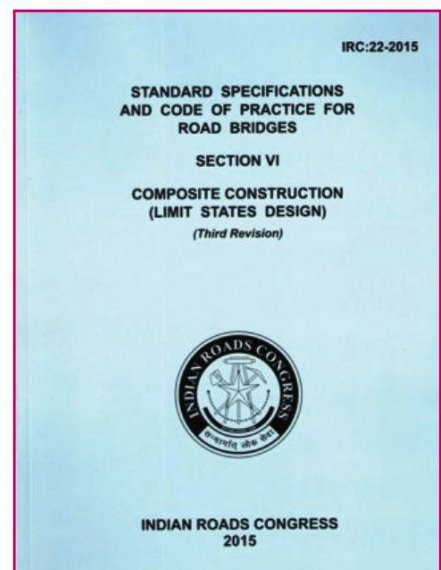
Cover: IS 800-2007: General construction in steel - Code of practice (third revision)



Wind Map: IS: 875 Part 3 - 2015: Code of Practice Design Loads (Other than Earthquake) for Buildings and Structures- Code of Practice: Wind Loads



Seismic Map: IS 1893 Part 1: 2016 Criteria for Earthquake Resistant Design of Structures General Provisions and Buildings



Cover: IRC 22 - 2016 Standard Specifications and Code of Practice For Road Bridges: Steel Concrete Composite Construction

INSDAG's Initiatives in New Code Formation / Revision

INSDAG has been instrumental in the process of development of codes related to steel trough BIS and IRC and its revisions since long. It has contributed largely the developments of IS 800, IS 801 which are the backbone of structural steel designing with Hot rolled and cold formed respectively. Apart from that INSDAG has contributed to codes of IRC 22, IRC 24, IS 808, IS 11384 and is convening the code IS 806 presently.

Conclusion

The complete ecosystem of infrastructure and construction has high space of use of steel at places where steel is most suited and useful.

Some of the important codes which may catalyse the infra development is already in place and some more have been identified for revision.

The Challenges and its solutions are well within reach and may be undertaken with proper initiative in a collective fashion. Only then will the target of 300 MTPA production will see a rational use and consumption. The nation is optimistic, and all stake holders look forward for achieving the same.

References: Online data from Public Domain/ JPC Portal/ World Steel Portal/ BIS and IRC portal

Acknowledgements: Shri Shiladitya Chanda, Asstt General Manager INSDAG.

Shri P K Mishra- Director General INSDAG.

Note: Inputs & Views are personal of the author (s) and not necessarily of FICCI