AUGMENTING STEEL CONSUMPTION IN INDIA

An INSDAG Perspective



Institute for Steel Development & Growth (INSDAG) Ispat Pragati Bhawan, 793 Anandapur, Kolkata 700107

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Introduction

Currently, ratio India's consumption of Steel to that of Cement is around 0.3, which is much lower than the ratio in many wealthy nations. In advanced countries, the ratio can reach up to 1.5. This is a small indicator, other than per capita consumption, towards the potential for our nation to use steel extensively.

India has the potential to dramatically increase its steel consumption in line with the industrialized nations, where there is a larger emphasis on using steel for various development and infrastructure projects. The nation's infrastructure development and building projects can benefit from steel's strength, durability, and adaptability. Moreover, Steel is environment-friendly, and that is how it scores over other competitive materials of constructions.

Increasing steel usage can also help growth in the economy of the country. The steel industry is a major sector for creating job opportunities, advancing technology, and energizing allied industries. A cascading effect would result from increasing demand for steel, sparking economic activity and advancing the nation as a whole.

Government, industry stakeholders, and policymakers need to work together to develop strategies that advance the use of steel in mainly infrastructure sector, to start with. Steel will help in making a more resilient and sustainable infrastructure landscape with new steel applications.

In conclusion, there is a lot of room for expanding the use of steel in India given the country's low per capita consumption and low steel-cement ratio. India can foster increased economic growth, innovation, and a more durable built environment by leveraging the benefits of steel and increasing its use in infrastructure and construction projects.

Scope and Objectives of the Report:

To the best of our knowledge, there is no single document available which contains the topics like benefits of steel as a material of construction, why steel consumption is low in India and what steps can be taken to augment consumption. Many studies /reports are available on how to increase production and availability of Steel in the Country. Not many reports are there which talk about what should be done to make people consume more steel, despite our per capita consumption being low. This report makes an attempt at compiling all that INSDAG has learnt in last many years on how to augment consumption of Steel in the Country. The idea is to reach out to Policy makers, Engineers and Architects, and above all, the actual end-users on the benefits of Steel and why Steel should be used more.

Many efforts are being made by individual producers of Steel for promoting their own brands and products, and in a way promoting the cause of Steel. However, it is important to know what steps can be taken collectively by Steel fraternity to augment consumption of Steel in the country. What is also important is to understand how the common end-users get to know and appreciate the benefits of Steel, and how the decision- makers give Steel its rightful place while selecting the material of construction. This document makes an attempt to compile all such steps and ideas in a nutshell. The activities and focus areas of INSDAG have also been stated in brief while highlighting the actionable points.

Steel is a more beneficial material of Construction on Life Cycle Cost (LCC) Analysis. Many international studies are available to buttress this point. Yet, LCC is not considered at present mandatory for competitive bidding considerations in General Financial Rules (GFR) of the Department of Expenditure, Ministry of Finance, Govt of India. This document re-emphasizes the need of LCC in bidding and suggests a proper scientifically carried out study on LCC.

This document will be developed from time to time to include the developments in areas of promotion of Steel. Suggestions from all stakeholders are most welcome.

Global Position of Steel Consumption:

Based on the figures of 2022, the top ten (10) wealthy countries (based on GDP) may be considered along with their total consumption of steel and per capita consumption of steel.

Country	GDP [*] (Tr \$)	Rank 2022	Consumption ^{**} (MT)	Rank	Per Capita Consumption ^{**} (Kg)	Rank
United States	25.46	1	94.5	4	279.4	16
China	18.10	2	920.9	1	645.8	3
Japan	4.23	3	55	5	443.6	6
Germany	4.08	4	31.6	9	379	8
India	3.39	5	114.9	2	81.1	31
United Kingdom	3.07	6	9.2	24	136.3	26
France	2.78	7	10.1	23	156.2	25
Italy	2.01	8	24.9	11	421.9	7
Canada	2.14	9	13.5	18	351.6	10
Russian Federation	2.22	10	41.7	7	288.3	14

Wealthy Countries (based on GDP) vs Annual Consumption in MT vs Per capita Consumption in kg in 2022 (Sources: *IMF and **worldsteel Association)

In the same year (2022), the top ten (10) countries of Steel Consumption (in MT) vs. per-capita consumption is compared.

Country	Steel Consumption [*] (MT)	Rank	Per Capita Consumption [*] (kg)	Rank
China	920.9	1	645.8	3
India	114.9	2	81.1	31
Other Asia	97.2	3	79.6	32
USA	94.5	4	279.4	16
Japan	55	5	443.6	6
S Korea	51.2	6	988	1
Russia	41.7	7	288.3	14
Other Middle East	32.2	8	169.2	22
Germany	31.6	9	379	8
Turkey	30.7	10	359.8	9

Annual Consumption in MT vs Per capita in kg in in 2022 (Sources: *worldsteel Association)

It is an accepted fact there remains a great scope for augmentation of Steel in India. Based on economic parameters, with GDP growing, the Steel sector is also poised to grow at CAGR 7-7.5% up to 2025. The positive factors are:

- Producers in the country today are lot more confident about the availability of various grades and profiles in sufficient quantities to meet the needs of infrastructure and construction sectors. Volumes are steadily growing.
- Focus of the Government on Infrastructure Spending is very high from year to year. INR 111 lakh Crores on National Investment Pipeline (NIP) initiatives upto 2025.
- 3. Housing and construction demand is growing at about 6-7% on CAGR basis
- 4. Major GOI initiatives include Housing for All, Bharatmala, Sagarmala, DFC of Railways, Metros etc.
- 5. Growth of Rural Housing at over 15% CAGR (Steel Consumption growth CAGR 6%)

Merits of Steel in Construction:

Accelerated Construction: Steel construction delivers quicker project completion thanks to effective pre-fabrication and on-site assembly, which drastically cut down on construction time. In fact, all Railway Bridges are made in Steel, primarily due to this consideration

Quality Assurance: High-quality steel from mills and carefully monitored off-site fabrication allow for exact quality control, providing predictable performance under load.

Sustainable Option: Structural steel is extremely recyclable and reusable, encouraging environmentally friendly building techniques and minimizing environmental effect.

Flexibility & Adaptability: Steel structures can be easily modified to accommodate future additions, adjustments, and repairs to satisfy changing needs.

Ideal for Long Span Structures: Steel has a large span capability that makes it perfect for long-span structures since it allows for column-free areas and maximizes the use of floor space.

Cost-Effectiveness: While steel may have greater upfront costs, over the course of a building's lifetime, costs will be reduced due to its durability and low maintenance requirements. Steel's natural beauty adds grace, power, and durability.

Design Freedom: Architectural ideals are supported by structural steel's unequalled design freedom, which fosters inventive structural engineering.

Simple Design Integration: Engineers continue to like structural steel because it allows for creative design solutions and money-saving techniques.

Ready availability: Various steel products and sections are readily available since the steel industry can provide the demand from the construction sector.

Environment friendly Construction: Off-site fabrication lowers pollutants at the job site, supporting a cleaner environment.

Low Water Usage: Steel construction uses the least amount of water compared to other materials, aiding in attempts to conserve water.

Strength and Durability: Steel buildings are strong and able to handle enormous loads and unfavorable weather conditions because to their high strength properties.

Versatility: Steel is versatile and can be formed and moulded into many different shapes, enabling creative and distinctive architectural designs.

Enhanced Safety: Steel buildings perform well in the face of natural calamities.

Space Efficiency: Steel's small-size beams and columns enhance floor space, providing the building with more usable space.

Performance Predictability: Steel's consistent qualities ensure predictable behavior, lowering construction risks.

Lightweight Foundation: Because steel is relatively light, it puts less strain on the ground, which could minimize the cost of designing and building a foundation.

Ease of Modification: Steel buildings are adaptable and can be quickly enlarged, giving them flexibility for upcoming alterations or expansions.

Sustainable Building with Steel:

Dry Construction Advantages: Steel-framed structures facilitate the use of lighter, thinner, and larger panels, promoting high energy efficiency through superior insulation materials. The dry assembly of building products reduces demolition costs and time, thanks to the lightweight nature of steel construction. Furthermore, steel's recyclability eliminates disposal costs, making it a valuable resource for downstream industries.

Infinite Recyclability: Steel stands out as the world's most recycled material, retaining its quality even after multiple recycling operations. Its ability to be endlessly recycled ensures its perpetual use in various applications, making it a fundamental and essential resource for a circular economic vision.

Social Benefits of Steel:

Minimized Disruption: Steel construction permits quick assembly, resulting in minimum interruption to the neighborhood surrounding the construction site, which has social benefits. A peaceful environment is aided by fewer vehicle movements, little on-site noise, and no trash.

Dismantleable and Re-buildable: Steel buildings can be dismantled and rebuilt without requiring messy demolitions, which benefits the neighborhood and has no negative environmental effects.

Steady Employment: The steel industry relies on settled, skilled personnel, which reduce the need for a nomadic workforce and provides steady employment prospects.

Aesthetic Appeal: Steel's strong strength allows for vast spans, which results in bright, airy buildings that make for pleasant living and working environments. Steel buildings also preserve their contemporary and timeless aspect over time since they do not deteriorate.

In conclusion, steel is a versatile, sustainable, and durable material for creating structures that withstand the test of time thanks to a wide range of advantages.

Challenges for use of Steel in Construction in India:

Cost Perception: Although steel-based construction has a favorable Life Cycle Cost (LCC) particularly for structures having long durability need, its greater initial cost prevents it from being widely used in comparison to alternative materials. For public utility structures, it is imperative to resort to LCC analysis, before choosing the materials of construction. General Financial Rules (GFR) 2017 and National Steel Policy (NSP) 2017 both emphasize the needs of Life Cycle Costing. Yet, the same is not happening in most cases in our country. Decision-makers normally get influenced by initial costs of the projects

Limited Knowledge: The benefits of steel over other construction materials are not adequately known by the general end-users, which results in sub-par utilization of Steel. Even faculties of many Engineering colleges are not equipped with knowledge of Steel Designs. Hence, young Engineers also do not get to know much about Steel during their college days. Skill levels of workmen in Steel constructions are also inadequate. Evidently, the current building practices are dominated by concrete based methods.

Market Segmentation: Market segmentation shows that while cost-sensitive markets like housing and commercial construction have not fully embraced steel products, steel is primarily employed in industrial constructions and sectors like railways. Multi-storied buildings are growing in number and size. Yet use of Steel in this sector is very limited due to a variety of reasons, some of which are discussed here. Similarly, road bridges are mostly made in concrete; whereas Steel should ideally be selected for such public utility structures which are designed for a life span of at least 50 years.

Focus on the Short Term Life of Structures: In infrastructure projects, the potential for longer lifespan of steel-based solutions is frequently overlooked in favor of initial expenses or concession period costs (up to 15 years).

Corrosion and Fire Concerns: Steel's susceptibility to corrosion and fire, coupled with the high costs of protection methods, poses challenges for its adoption in housing and commercial sectors.

Lack of Demonstrative Structures: The dearth of steel-based buildings in emerging regions contributes to a lack of faith in employing steel for a variety of construction projects. As most constructions particularly Government owned buildings and structures (housing and public utility structures) are taking place in concrete, common users tend to accept concrete as the best method of constructions.

Availability of alternative building materials and local influences: In some instances, concrete, bricks, and wood are preferred over steel because they are more widely accessible and more affordable. It's possible that historically in India, traditional construction methods did not give priority to the use of steel because of cultural and architectural choices. Availability of stone, woods and other local construction materials (than Concrete) are important aspects of traditional method of construction.

Lack of Life Cycle Cost Analysis: The National Steel Policy 2017 advises against skipping this step during competitive bidding for public utility infrastructure. LCC should be a major factor for consideration during bidding. General Financial Rules 2017 also emphasizes LCC while evaluating bids. However, LCC is not so far mandatory in bidding, and hence the Steel based designs get overlooked at times.

Skilled Workforce Shortage: The lack of a skilled workforce in steel construction, particularly in fabrication and erection, poses challenges. Only few vendors are proficient in using sophisticated software like Tekla for design, detailing, and fabrication, leading to a disconnect between design and fabrication processes.

Curriculum in Undergraduate Engineering Course: Not many Engineering colleges have faculties, who are conversant with Steel based applications. As such imparting knowledge on Steel designs, applications in such colleges is not adequate. Students also take low interest in learning about steel designs.

To fully realize the potential of steel in the Indian construction sector, it will be necessary for industry stakeholders, policy makers and the construction community to work together to raise awareness about benefits of Steel and encourage steel-intensive construction

Potential Use of Steel Based Structures (Sectoral study):

A summary of areas where steel may be considered may be as follows. In some areas Steel is getting used; but the scale of usage can be augmented. The brief details are given for a cursory look at usage of Steel

Broad Areas	Brief Details			
Infrastructure	Heavy duty (thicker and bigger depth) steel deck profile sheet of steel for bridge applications. Sheet Piles for ports and harbours, Tubular piles			
innustructure	Sheet Piles for steep and deep excavations			
	Refurbishing worn out bridges with steel			
	Steel tubular Sections & monopoles			
	Innovative and aesthetic Steel staircases			
Architecture	External Wall Facades with artworks in the form of motives, cut outs, mosaic designs			
	Country Border Fencing			
Defense & Border	High Mast Lighting			
Management	Elevated Security post/ watch towers			
0	Sky walk, Foot over bridge			
	Modular temporary bridges- Bailey Bridge/ Pedestrian suspension bridges			
	Airport Terminal Buildings			
	Airline hangers			
	Airlines maintenance sheds			
Civil Aviation	Aero bridges			
	ATC Towers			
	Watch Towers			
	Cargo Sheds			
	Baggage handling system structures			
Rural Electrification	Transmission towers			
	Single pole transmission lines			
	Lighting masts			
	Electrical substation structures			
	Silos for grain storage			
Food Processing	Material handling steel structures			
	Stainless Steel Equipment			

Broad Areas	Brief Details				
Renewable Energy	Wind mill supporting masts				
Renewable Energy	Solar panel supporting structures				
Car Parks	Multilevel Car Parks				
Housing	Pre Engineered Building with Light Gauge Steel Doors, Windows, Walls Plain Profile sheets Embossed Profile Sheets				
Highways	Crash Barriers High mast lighting poles Signage structures Low Relaxation Pre-stressed Steel Strand (LRPC) Continuously Reinforced Concrete pavement (CRCP)				
Electric Vehicle Charging Stations	Steel Canopy's and Charging Equipment supporting structures				
Large-scale energy storage systems	Battery enclosures, structures for compressed air energy storage				
Drone Infrastructure	Landing pads, take-off and landing platforms, drone hangars				
Personal Protective Equipment (PPE):	Steel-toe boots, protective gloves with steel reinforcement, steel mesh face shields				
Water Treatment Systems	Filtration systems				
Sustainable Packaging Solutions	Reusable stainless steel containers and bottles				
Urban Gardening Structures	Steel structures as vertical gardens				
Smart Home Devices	Steel frames in smart door locks, thermostats, security cameras				
Roofing materials	Of various curves and shapes				
Playgrounds and Recreational Equipment	Sturdy and safe playground equipment, swing sets, climbing structures, slides, fitness stations				
Safety Equipment	Protective traffic barriers, guardrails, safety gates, barriers for construction sites				
Art Installations	Large-scale art installations, statues, artistic gates, artistic structures				

Broad Areas	Brief Details
Greenhouse Structures	Steel-framed greenhouses
Portable Shelters	Portable shelters for emergency response, disaster relief, temporary accommodation
Modular Housing	Prefabricated off-site using steel frames and panels, can be easily transported and assembled
Urban street Furniture	Create innovative and durable benches, street lamps, bicycle racks, and public art installations
Adaptive Reuse and Renovation	Incorporating steel elements, such as beams and columns, into older buildings Create modern additions or extensions to existing structures
Data Centers	Storage racks Building frames
Warehousing	Storage racks

Key steps on how to Augment Promotion of Steel:

- a. Product Innovation and applications in Construction: Focus on developing cutting-edge products like light gauge, high-performance galvanized, and color-coated steels, offering enhanced properties for various construction applications is required. Production of some such grades are happening; how to promote these grades in Construction areas is important
- b. Collaborative Solution-Oriented Approach: Emphasize collaboration with builders and allied service providers to offer comprehensive solutions rather than just products, especially in the construction of tall buildings, which is a growing trend in the country. BIS, Institutes like INSDAG, Engineers and Architects should all come together to help this kind of collaborative approach.
- *c. Promoting Composite Solutions*: Highlight the benefits of using composite solutions like Steel-Concrete, Steel-Glass, and Steel-Aluminium in construction projects, which offer superior performance and design flexibility.
- d. Embracing Sustainability and Resource Efficiency: Leverage the current emphasis on sustainability by showcasing steel as a green and recyclable material, contributing to resource efficiency and reduced environmental impact.
- e. Service Innovations and Supply Chain Improvements: To improve the whole construction experience and efficiency of steel-based projects, invest in service innovations and supply chain improvements. Supplies of right steel in semi-urban and rural areas are still an issue
- *f. Workforce Skilling Initiatives:* Implement programs to up-skill and train the workers involved in steel construction to ensure that they are highly competent and capable of meeting the expectations of the sector.
- g. Rural Initiatives: More focused attention is required for promoting Steel in Semi-urban and Rural areas. Awareness Campaigns, demonstrative low-cost structures, supply chain management and skilling of workmen are some of the areas which need to be addressed for promotion of Steel in such areas. Help of all major Steel Producers and the Ministry is required.

h. Analysis of Life Cycle Costs (LCCA): The Life Cycle Cost Analysis (LCCA) measures all expenses incurred throughout the course of a plant's or piece of equipment's life, including upkeep, repairs, and end-of-life resale value. In existing methods, project costs are mostly based on capital or upfront costs without taking into account the consequences for life cycle costs.

Life Cycle Cost Analysis (LCCA) for Public Utility Structures: Benefits of Steel over RCC:

In terms of Life Cycle Cost Analysis (LCCA), Steel performs better than Reinforced Cement Concrete (RCC) and Pre-Stressed Concrete (PSC) when evaluating for Public Utility Structures, such as bridges and infrastructure. Following is a summary of steel's main benefits when LCCA is adopted:

Reduced Maintenance and Repair Costs: Compared to RCC and PSC, steel structures have lower maintenance and repair costs, which results in cost savings over the course of their full life cycle.

Superior Resistance to Environmental Deterioration: Steel has increased durability, resulting in a longer service life and fewer repairs being required.

Reusability and Recyclability: Steel is naturally highly reusable and recyclable, enabling the effective reuse of steel components and the deconstruction of buildings at the end of their life cycles, both of which improve LCCA results.

Higher Resale Value: Steel has a higher resale value than RCC and PSC due to its recyclability, which makes it a longer-term more cost-effective option.

Steel emerges as the preferable and sustainable alternative for public utility structures by taking these aspects into account in the life cycle cost evaluation. Steel offers long-term economic benefits through decreased maintenance costs, an extended lifespan, and a higher potential for resale or reuse.

Specific action points for Augmentation of Steel in Construction:

- a. Set up a framework for Life Cycle Cost Analysis (LCCA) by carrying out Life Cycle Costing methods for infrastructure assets in line with requirements of the Department of Expenditure, Ministry of Finance, and include the same in GFR for bidding process. NSP 2017 also recommended LCC.
 - INSDAG has already made an Approach paper which has been circulated among all Founder members and Ministry of Steel (MoS). MoS has been requested to form an expert committee who will oversee the project of LCCA Framework.
- b. Standardized drawings of steel / steel-concrete composite bridges (20 m to 60 m) for use in MoRTH and other user Departments will help
 - INSDAG has already made available the standard drawing of 30 m span to the Ministry for 6 widths. MoRTH to be persuaded to implement the Steel designs.
 - More such standard designs are required for ease of end-users for consideration of Steel bridge in place of Concrete
- c. Teaching Resource Materials (TRM) It is important to make available in one place the study materials relating to Steel designs in terms of latest Codes and Standards , and this will help both faculties and Students in Engineering Colleges to know more about Steel-intensive usages
 - INSDAG is already engaged on this task
- d. Implementation of CRCP (continuously reinforced concrete pavement) in Roads along monsoon prone, inaccessible and low maintenance stretches of highways / expressways / state highways
 - INSDAG has made a report on the benefits of CRCP in Highways
 - Important is how to make the user departments adopt these technologies
- e. Cover all unguarded embankments along roads with suitable crash barriers.
 - It is important that quality standards of Crash Barriers are maintained

- f. Identification of ways and means to use steel in regional housing typologies to enhance durability
 - One PMAY project is being carried out in MNIT, Jaipur in association with SPA, Bhopal. INSDAG has already provided inputs to the Group for use of Steel intensive designs.
- g. Inclusion of more steel design related courses in Undergraduate curricula through AICTE
- h. Continuous engagement with Bureau of Indian Standards (BIS) and Indian Roads Congress (IRC) for formulation and /or updation of standards and codes related to steel use in construction.
- i. Recommendation of steel sheet / tubular piles in port activities through Ocean Engineering Department of reputed IITs.
- j. Interactions with Research Design & Standards Organization (RDSO), Lucknow & Central Organization for Railway Electrification (CORE), Allahabad to identify the issues and opportunities of use of steel in rail coaches, bridges, foot bridges and electrification
- k. Development of special grade steels for defense sector in collaboration with advanced research laboratories under IITs, IISC, National Metallurgical Laboratory (NML), Defense Metallurgical Research Laboratory (DMRL) etc through special funding of Ministry of Steel
- I. Regular awareness sessions in form of seminars, workshops with stakeholders of construction industry
- m. Focused training sessions on steel related topics of contemporary interests
 - INSDAG undertakes Training Programmers and workshops within its resources. What is required is to raise the level of the campaign with help from Steel majors and MoS
- n. Involvement of other user departments such as MoRTH, MoHUA, Railways and Finance is required for steel promotion. Suitable Steel-Intensive projects are to be identified.
- o. Creating large-scale awareness campaigns for sharing benefits of Steel among common users

- All major Steel Producers should join hands for these campaigns
- p. Promoting High Strength Low Alloy Steel in Construction
- q. Conducting various training with educational institutes which will influence teachers and students

Organizations / Institutes for Collaborations:

Academic Institutes	CSIR	Government	Regulatory	Promotional
	Laboratories	Departments	Bodies	Institute
IITs, NITs, Reputed Engineering Colleges in State levels. NIDPR, a few architectural schools of repute	SERC, CBRI, CRRI, CECRI	MoRTH, MoHUA, CPWD, BMTPC, MoRD, MoFPI	BIS, IRC	INSDAG

- Many IITS and NITs have been requested for collaboration with INSDAG for projects relating to promotion of Steel and associated areas of mutual interests
- MOU has been signed with NIT Patna. MOUs with Jadavpur University-WB, IIEST, Shibpur and IIT Patna, SPA-Bhopal are under consideration
- Letters written to Department of Skill Development and Entrepreneurship, GOI, and the Institutes under this Ministry for allowing INSDAG for conducting programmes on skill development on use of Steel
- Similar letters have also been sent to Institutes under Ministry of Rural Developments

Present Focus areas of INSDAG:

INSDAG is trying to work in line with all that are being done in SCI UK, the entity which was the model for INSDAG. Some of the major initiatives which are being pursued at present:

- Life Cycle Cost (LCC) Study
 - Approach paper circulated among the stakeholders, including Ministry of Steel (MoS).
 MoS has been requested to form a Committee so that INSDAG can undertake the study with guidance of the Committee
 - IIT Bombay is helping INSDAG in the process; so also Steel majors like JSW Steel and Tata Steel
- Preparation of Standard Drawings of Steel / Steel-concrete Composite Bridges for MoRTH through an expert committee
 - 6 sets of design for various widths for 30.0 Metre span, submitted to MoRTH through MoS.
 - Awaiting directives from the Ministry for such works in respect of other spans (35m & 40m)
- Design and implementation of Certificate Courses on Steel Designs through reputable academic institutions to impart skills on Steel Designs
 - Local engineering colleges like Jadavpur University, Kolkata and IIEST, Shibpur, West Bengal are being approached.
 - IIT-M and IIT-H have also been approached
- Regular interactions with Bureau of Indian Standards (BIS) and Indian Road Congress (IRC)
 - Codes and Standards are a big enabler for usage of Steel
- Focussed training / workshops on Steel Design, Composite Construction, Pre-Engineered Buildings etc. (topics of contemporary interests)
 - Training calendars are posted on the INSDAG website
 - 4 seminars on contemporary topics planned one in each region
- INSDAG has also initiated steps for providing "One-Stop Solutions" From design to execution for clients who are interested in Steel-Intensive Structures
- INSDAG is in discussion with AICTE for inclusion of more course contents on Steel in UG Engineering Courses.

Rural Initiatives – Upgrading the available designs of Low–Cost Houses with latest construction technology and steel grades.

Participation in Developments of Codes and Standards

Codes and standards are an important enabler in promotion of Steel. Since inception, INSDAG has been actively associated for development of various steel related Codes and Standards under BIS and IRC like IS 800, IS 801, IS 808, SP 6(2), IRC 22, IRC 24 etc. Being member of various committees of BIS & IRC like CED7, CED54, MTD4 and B5, regular interaction and deliberation on different codal provisions are regularly undertaken by INSDAG. Apart from basic codes and standards, INSDAG had prepared many handbooks to various codes for easy and fast understanding for the users. For propagation of steel usage in Bridges and Culverts in Rural and Semi Urban areas, INSDAG developed some standard Design and Installation Manuals for National Rural Infrastructure Development Agency (NRIDA) under Ministry of Rural Development for construction under Pradhan Mantri Gram Sadak Yojana (PMGSY).

After release of IS 800 : 2007, INSDAG has long been pursuing the Engineering Colleges for inclusion of Structural Steel Design and Construction into their curricula. To facilitate such initiatives till date we had conducted 23 nos of 6 days Short Term Training Programmes (STTP) on Structural Steel covering almost all the concerned faculties of Engineering Colleges spread across India. Nowadays almost all premier institution teaching Civil Engineering and Architecture & Town Planning, adopted Structural Steel design with Limit State Method into their curricula.

Development of Teaching Resource Material (TRM)

To promote the use of steel and ensure up-to-date knowledge among civil engineering faculties and professionals, INSDAG took the initiative during its formative years and assembled a team of experts from prestigious institutions such as IIT Madras, Anna University, and SERC, Madras, under the leadership of Dr R Narayanan, a retired expert from SCI, UK. The team's goal was to create a comprehensive teaching resource for Structural Steel Design. This material comprised 45 chapters spread across three volumes and was published in 2001. Additionally, the team prepared accompanying PowerPoint presentations (PPTs).

The Teaching Resource Material (TRM) proved invaluable in educating civil engineering faculties about limit state design of steel structures. INSDAG organized several workshops and seminars to disseminate this knowledge to faculty members, students, and working professionals.

At the time the TRM was prepared, the prevalent code for Steel Design was the Working Stress Method (WSM), leading to the reference of BS 5950, which followed the Limit State Method (LSM). It is worth noting that the LSM is more rational when compared to the WSM. However, the latest Code, IS: 800-2007, has now adopted the Limit State Method, and various relevant codes have been revised during this period.

In light of these developments, INSDAG intends to update the teaching resource to align it with the latest codes and advancements in steel design.

In summary, the teaching resource created by INSDAG has been instrumental in promoting steel in civil engineering, and INSDAG is now planning to revise and update the same to stay current with the latest codes and innovations in the field of steel design.

Efforts to Promote Consumption of Steel in Rural Areas:

It is observed that growth of steel consumption has taken place largely at the urban segment where lots of developmental activities are taking place. On the other hand, despite rapid increase in agricultural production in India, coupled with improvements in the quality of rural life, the level of rural steel consumption has not risen to a notable height. Steel consumption in rural areas is less than 10 kg per capita annually. Therefore, it is important to focus on Rural Areas in terms of developing awareness about Steel. Public Utility structures like Panchayat Halls, Schools and Health Centres can all be made in Steel in a cost effective manner.

INSDAG has taken up a good number of activities / initiatives to enhance steel consumption and to create the awareness for more of steel usage.

The following are the areas / activities initiated in the rural segment to boost consumption:

- (i) Organized steel campaign in rural areas by training the local engineers, architects and masons on the benefits of steel usage and promote best practices using reinforcement bars and other commonly used steel products. Till date, 80 number of such Training Programme covering about 4300 nos. of local engineers, architects and masons were conducted by INSDAG in association with SAIL, Tata Steel, RINL and JSW. In 2022-23, INSDAG has conducted 7 nos. of trainings for the masons in the rural and urban areas and about 365 masons were trained on good practices of construction with TMT bars.
- (ii) Developing designs of model Rural Houses, Anganwari Panchayat Hall, Community Toilet with steel. INSDAG has brought out brief publications on the designs of all these structures in rural areas and translated in vernacular languages in Hindi, Telegu and Bengali.
- (iii) Products useful for rural area such as Roof Truss, Furniture (Almirah, Chairs, Tables, etc.),
 Bridges, Grills (Windows / Doors), Agricultural Equipment and Tools be promoted by
 following ways mainly:
 - Training on Design of items of Rural Applications
 - Skill Development Programs of Rural Fabricators
 - o Demonstration of Critical Applications such as Rural Bridges
- (iv) Developed prototypes of low cost houses with tubular steel frames and ferro-cement panels as walls and roofs in West Bengal, Maharashtra and Tripura. Cost of such houses would be Rs.1700/- per sq ft. which will be competitive compared to the same model with RCC beam column, roof and brick walls. A model house was constructed at the campus of National Institute of Rural Development and Panchayati Raj, Hyderabad.
- (v) Developed two variants (rural and urban) of steel based toilets with stainless steel fittings and fixtures. Prototypes of toilet were displayed during IITF 2015 at New Delhi for dissemination of knowledge.

- (vi) Developed prototype community grain storage bin jointly with Indian Grain Storage Management & Research Institute (IGMRI), Hapur, UP and distributed among the beneficiary in Gonda, UP.
- (vii) To give further impetus on capacity building in rural areas in terms of fabrication, INSDAG coordinated with Dept of Micro & Small Scale Enterprises and Textiles, Govt. of West Bengal for development of Industrial Clusters of Steel Fabrication under MSME Extant schemes at various parts of the state. INSDAG submitted detailed report on development of six "Common Facility Centres (CFC)" in six approved districts in West Bengal. Hand holding support for setting up Industrial clusters is now being imparted to selected center
- (viii) To collaborate with various State Govt. agencies, to start with West Bengal, and find out where steel intensive structures can fit in. Presently, INSDAG is working with State Urban Development Affairs (SUDA) in West Bengal.

INSDAG's involvement in various Projects for promotion of Steel

Restello at Kolkata

The HIG (High Income Group) Project is a B + G + 6 steel-framed and steel-concrete composite building. It comprises 12 apartments in duplex style. The project provides 25 covered car parks and 15 open car parks. The building was designed with both braced and framed structures to ensure stability and strength.

Indira Paryavaran Bhawan at New Delhi

The first on-site net-zero building in India is the Indira Paryavaran Bhawan, which is situated in New Delhi. Out of four blocks, one block (G+7) that houses an auditorium at the ground floor, was built with steel-concrete composite technology

Handloom House at New Delhi

The corporate office of Ministry of Textiles, Govt of India on Janpath Road, New Delhi was fully constructed with Steel-Concrete Composite methodology.

Ispat Pragati Bhawan at Kolkata

INSDAG's own building at Kolkata is fully a steel made building.

Support expected from Ministry of Steel and Founder Members:

- Proposed LCC Study should be immediately taken forward
 - IIT-B has been requested to provide a preliminary document on why LCC study is important. The same will be submitted to the Ministry and the Founding Members in the 1st Week of August 23. The Ministry may please form a committee of experts, as already requested.
- Working out a country-wise campaign on the merits of Steel with help of Steel Majors
 - The contours of the campaigns may be decided by the representatives of Founder Members. INSDAG will take active part in the exercises
- > Demonstrative structures on Steel in Steel Cities
- Project assignments to INSDAG on subjects relating to promotion of Steel (like low cost housing under CSR)

Conclusions

- 1. Steel needs to be presented as a forward-thinking, environmentally friendly, and creative material of construction that can adapt to the changing demands of the Indian building market.
- 2. It is important that structured deliberations, and then action plans are made through collective efforts, to promote the cause of Steel. INSDAG is making its small effort within its resources. What are happening in advanced countries in use of Steel is to be emulated based on suitability. INSDAG is presently trying to benchmark against activities of SCI UK to the extent possible. Even some ideas from Japanese Society of Steel Construction (JSSC) have also been adopted.
- 3. Important areas like LCC Study, AICTE curriculum updation, making updated Teaching Resource Materials, Country-wide awareness campaigns about benefits of Steel, Focus on Rural initiatives need full support of the main producers of steel as well as the Ministry of Steel, Govt of India.

Contacts : Director General Institute for Steel Development & Growth (INSDAG) Ispat Pragati Bhawan 793 Anandapur, EM Byepass Kolkata 700107 Email : ins.steel@gmail.com / insdag@rediffmail.com