



'STEEL'ING THE SHOW

APART FROM ITS LIGHT WEIGHT, STEEL IS FLEXIBLE ENOUGH TO BE WRAPPED, TWISTED, BENT AND WOVEN

BY NATASHA SHAH

One of the most trustworthy materials, steel has tiptoed its way into every aspect of building construction. It has travelled a long way from its use as mere structural supports to lanky skyscrapers and extensive bridges. As a material that can be crafted, CNC cut, wrapped, twisted, bent, tapered, woven and riveted, it has made its way into a variety of uses – from solid steel-clad facades to whimsical churches, it continues to charm architects and builders.

"Steel has now become viable as an ecosystem, as the speed it offers is suited to project requirements – especially in urban projects where a reduction in construction period directly translates into revenue for the developer," explains Pranav Iyer, principal architect, Ground11 Architects. "It is also an excellent material for quick and inexpensive low-cost housing, which is the component with the largest demand in India."

The third millennium architects have started experimenting with the possibility of changing the direction of loads and their unloading (from the mundane vertical transfer of loads) like pieces of a jigsaw puzzle. "Steel proves to be relevant and ben-

eficial to several construction verticals," opines Arvind Nanda, CEO & founder director, Interarch Building Products. "It works well in the tropical environment, and a steel building does not look any different than any other when finished. Moreover, the perception shift in the residential space has also started."

With a level of flexibility provided to design aspirations, steel solves structural problems of longer spans and tall unsupported heights, apart from construction challenges faced by flamboyant, organic forms. Adds Hiren Patel, proprietor, Hiren Patel Architects, "It makes the structure light and, hence, it has extreme compatibility in earthquake-prone zones."

A notable and impressive use of steel is seen at the Zayed National Museum Building at Abu Dhabi by Foster + Partners. The project consists of five towers made from lightweight steel, sculpted aerodynamically to work like the feathers on a bird's wing. Balancing the structures with a more monumental interior experience, the galleries are anchored by a dramatic top-lit central lobby, which is dug into the earth to exploit its thermal properties. This brings together shops, cafes, an auditorium and informal venues for performances of poetry and dance.

1. Steel was found to be the most viable construction material for Weikfield IT Citi Infopark, Pune, designed by Ground 11 Architects.



2. Weikfield IT Citi Infopark, Pune, is a structural hybrid of RCC frame with post-tensioned slabs and a steel structural frame.

3. Zayed National Museum Building at Abu Dhabi by Foster + Partners.

THE ROAD TO GLOBALISATION

As a vital contributor to the country's fast-paced development; be it general infrastructure, commercial or institutional buildings, or even projects in the hospitality sector, implementation of steel design and construction is proving to be a good bet in achieving both long-term and short-term goals. "In the current millennia, India is experiencing a wave of rapid urbanisation more out of necessity. Successive governments have not been able to provide for the essential needs of the population," notes Brijesh Chinai, founder and CEO, Bric Design Group, "Through steel, we can realise a cost-effective solution for at least basic housing for the masses. The use of prefabricated steel in dry construction can provide shelter within a short frame of time."

Although more expensive than conventional brick and concrete, the ease of construction due to off-site fabrication and easy installation, apart from the availability of computer-aided fabrication, makes steel a much more viable option. As one of the world's most recycled products, steel offers longer life spans and lesser degradation. "Steel as an alternative to concrete has matured, with an incredible range of uses within architecture, often in conjunction with concrete. However, a pure steel superstructure in India is rare," notes Iyer.

WEIKFIELD IT CITI INFOPARK

The project is a 1.2 million sq-ft IT Park with both multi-tenant and BTS facilities. The masterplan includes the Hyatt and Novotel hotels, and is on a 21 acre site. The project was designed by R Chakrapani & Sons, with Ground 11 Architects. The buildings have a 55,000sq-ft floor plate divided into 20,000 and 30,000 with a central, compact core; the 20,000sq-ft floor plate blocks can be subdivided into offices of 3,000sq-ft each. The project is a structural hybrid of RCC frame with post-tensioned slabs and a steel structural frame. The use of steel was based on the results of a thorough time and cost based analysis of various available structural solutions. Steel as a material was found to be most viable in components of the design programme, where flexibility offered overshadowed any cost or time constraints. In architect C Vijayram's opinion, "The future of steel in India is based not on how much faster or cheaper it would be, but on the inherent malleability of steel as a design material." Vastech, Pune were the structural consultants for the project, who at that time almost single-handedly brought Post-Tensioned slabs into mainstream construction in Pune.

"The pace of infrastructure development in the country is going to accelerate in years to come. Stemming from the pre-engineered buildings industry, what is taking shape is the application of pre-engineered construction to new heavy engineering and larger infrastructure projects – which is next in line for development in the country. Projects like 100 Smart cities, new no-frill airports at various cities, international terminals, industry corridors, power plants, ports, etc, require heavy steel structures and a different approach in comparison to pre-engineered buildings. The opportunity in these sectors is huge, and we are all geared up," adds Nanda.

"Our practice considers steel a conventional material," says Revathi Kamath, principal architect, Kamath Design Studio. "Structural steel has been part of our vocabulary for more than three decades. We have used it in low cost, as well as medium and high-end projects," she explains, adding that, even 25 years ago, the ease, speed and costs at which dry construction could be carried out was extraordinary.

"Over time, the ISMB (Indian Standard Medium weight Beams) girders evolved into more efficient and aesthetic versions; castellated girders, trusses made up of tubes and steel bars of various spans, depth and lacing designs. These ensembles were crafted at site or in a workshop. Steel in these forms have been used in projects ranging from houses to schools, community centers, cathedrals, luxury hotels and museums. The visual quality of structural steel is an integral part of the aesthetic character of all these projects," Kamath explains.

At project planning stages, the major issues factored in during decision making, is the time and space available for construction. In a fast developing nation such as ours, and the parallel population boom, packing in more constructions in shorter time spans is a crucial advantage. Steel has thus proven to be the 'go-to' solution, which encompasses a wide range of construction challenges.

It is excellent at space saving, which directly transforms into revenue for builders. Suresh Athavale, architect and professor, BN College of Architecture for Women, explains, "If you compare the size of RCC column and steel column, steel wins hands down. In a 15-storey commercial building project, the column grid is 7.5x7.5m and the column size at the ground floor for RCC is 900x900mm and steel 300x300mm. You calculate the area saving." He notes that steel is an excellent choice



4. Kamath Design Studio uses steel for most of its projects, from residential to institutional.

5. Brijesh Chinai, founder and CEO, Bric Design Group.

6. Pranav Iyer, principal architect, Ground11 Architects.

7. At 33m, The Gateway, at Raigarh by Kamath Design Studio is the tallest stainless steel structure in South Asia.

for high-rise buildings, and that residential projects are areas where an optimum use of steel has not yet been tapped into. "Also, fabrication and erection are aspects that play a vital role – and we aren't fully equipped for that, especially for structures where the design is complex," he points out.

Vinay Shroff, senior VP – Sales and marketing head – Retail, JSW Steel, agrees and adds, "As leaders in the steel industry, it is our responsibility to promote quality construction. It is our endeavour to reach out to masons and fabricators and improve their skill sets. For example, partnering with INSDAG (Institute of Steel Development and Growth) for ESDP (Entrepreneurial and Skill Development Program) aims to provide training and encourage entrepreneurs."

CURRENT DEVELOPMENTS IN STEEL TECHNOLOGY

The advancement in technology has now made steel available for use in many sectors. "One of the upcoming segments is solar. With the government focus on renewable energy, demand

for steel in the solar segment for panels is bound to increase," Shroff envisages. "In the infrastructure segment itself, application of steel has diversified – like crash guards, commercial and industrial buildings, concrete expressways and highways, to name a few. For the overall growth of the nation, infrastructure development will play a key role. Hence, the construction and infrastructure segment will continue to drive growth of steel consumption."

The construction market is continuously exploring the capabilities of steel being used as a standalone material, making the material aesthetically pleasing enough to be used as cladding as well. As an informed and rebellious response to this mechanical routine of building construction, designers around the world have begun to push the boundaries of traditional thinking – creating designs that leave a lasting impression in terms of architecture, as well as providing a positive nudge for their contemporaries to do the same.

"There are lots of opportunities ahead that would be our focus in the coming year," envisages Nanda. "For instance, thanks to the speedy progress of the Metro rail system, the scope of pre-engineered buildings is immense. Also, the increasing emphasis on Green building construction seems to be adding to its growth. Overall, the commercial construction market has witnessed the use of pre-engineered buildings in India; but the residential section is yet to further explore this massive constructional shift by adopting PEB as the viable solution. We aim at exploring these new avenues and possibilities to further strengthen and increase the role of pre-engineered buildings in Indian infrastructure."

Another area that could be explored is the possibility of dismantling old steel structures and reusing the steel in new projects. In the current economic climate, deconstruction and rehabilitation of an existing structure can prove to be more cost effective than building a new facility. Explains Chinai, "The future of the construction industry could be changed completely if the concept of demountability is driven at larger scale structures. Large-scale demountable buildings with longer lifespans is a feasible proposition – one that would take the steel used in existing buildings for new projects, thereby avoiding the need to smelt new steel." Thus, it would introduce deconstruction as the end point of the lifecycle of a building, rather than demolition.



8. Jindal Auditorium at Raigarh by Kamath Design Studio, is a steel structure made of girders, plates and rods manufactured at the adjacent steel plant and fabricated by local welders on site.

9. Suresh Athavale, architect and professor, BN College of Architecture for Women.

10. Hiren Patel, proprietor, Hiren Patel Architects.

11. Community Centre by Hiren Patel Architects, used steel roofs and columns to create an extension.



TOWARDS SUSTAINABLE ARCHITECTURE

The current architectural movement, however, has environmentalists and designers circling back to earth architecture and designs with zero carbon footprints. No doubt, such a scenario tests the agility of the steel industry with regard to aesthetics and energy efficiency.

While construction time and construction space lie at the crux of planning of every project, awareness of the importance of aesthetics and cultural adaptability sees a steady rise among contemporary architects. Steel has proved its ability to mould itself to create motifs and architectural symbols that mark our architectural milestones of the past. Its adaptability to every form, function, climate and demographic has eased its ascent into the architectural language of every region.

With advances in technology, structural design models can reveal the tectonic quality of steel structures, enabling architects and engineers to assign interesting aesthetics, while also making it efficient and economical. Steel offers greater flexibility in framing as well as variations in form, in comparison to concrete. "It has an obvious advantage over concrete as a much cleaner material to use on site," notes Iyer, "Steel reduces the damage sustained by project sites because of the cement dust that kills the soil."

The coming years may witness a trend that would trigger a greater demand for more prefabricated and less site-intensive construction. To illustrate, Chinai looks back into the past to one of the early prefabricated steel structures. "Since I have always been an admirer of heritage, I would like to think of how the Empire State Building, constructed in 1931, continues to amaze people to this day," he contemplates.

COMMUNITY CENTRE

The concept was to find an underprivileged urban area and to use it positively by reforming and restructuring the place. This included retaining and modifying existing structures and adding a few more in this complex to create a community-learning place. The architects had to reuse the basic structure, which was absolutely unstable and risky — since it was originally made by the locals without technical assistance. Not wanting to affect local community emotions, the architects kept the existing building intact and modified and refurbished the degrading bits of the structure. This saved half the cost that would have been required to create a new building. Reinforcing it with steel columns and adding a steel roof on the first floor made an extended workspace in the classroom. Now, with its combination of a steel-truss roof, coloured glass and eco-friendly bamboo screens, it is one of the best spaces in the building.

The Empire State Building was constructed using up-to-date technology, where a substantial concrete foundation took the weight of the steel framework of the building. All the steel sections were prefabricated to exact sizes within 2mm tolerance, and prepared so that they could either be bolted together or joined with rivets. It only took three days for the sections to be manufactured in the steel mill, transported and positioned in the framework as part of the buildings structure. The average growth of the tower was one storey a day.

"Clients, architects, contractors and even authorities are mostly inert about it," points out Athavale. "If you say, 'Use steel, it saves construction time' — the answer is 'We are not in a hurry'. If you try to explain how it is environment friendly, then you sense that they are least concerned. Thousands of litres of water are wasted on construction sites. So, when I said, 'You will save water and thus save money', I was told by a company head, on one of the construction sites, that they don't pay for water!"

Shroff suggests that "the fragmented construction industry should evolve and should start integrating the technology to bring economies of scale and improve quality. It should provide end-to-end solutions to the customers. Customers are looking at solutions more than just the products. We believe that we can make a difference by providing those services and solutions."



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12. Kings Cross Station, London, designed by John McAslan + Partners, has tree-shaped steel structures.

13. Vinay Shroff, senior VP – Sales & marketing head – Retail, JSW Steel.

14. Arvind Nanda, CEO & founder director, Interarch Building Products.

15. Museum of Tribal Heritage by Kamath Design Studio, is built with steel tubes, castellated girders and steel rods fabricated into intricate trusses.

STRENGTHENING OLD ROOTS

With concentrated development in the urban metropolises of the country, most projects are facing space and time crunches. Heritage conservation and adaptive reuse is being tapped into, as a possibility. This not only leads to the restoration and refurbishment of the old structures, but also evolution of these spaces to house evolving functions.

The use of steel reinforcements, roofing or localised façade solutions proves to be a boon in this regard. “We are watching such outstanding buildings collapse today due to ageing of stone/brick masonry and weakening wooden support members,” says Patel. “Reuse and reclamation of these buildings is a top priority for the conservation of our heritage, which is a lesson we need to learn from Europe. Steel is the best material to strengthen such structures and keep the aesthetics intact.”

Notes Iyer: “Steel allows surgical precision in terms of structural supports and can easily provide an endo-skeleton for an aging structure without overtly destroying its character.”

A fine example of such adaptive reuse is the concourse at Kings Cross Station, London, designed by John McAslan + Partners. The project included the full restoration of the five

MUSEUM OF TRIBAL HERITAGE

The Museum of Tribal Heritage at Bhopal was commissioned by the Government of Madhya Pradesh in 2006. The Museum is designed to create a built fabric, which the tribal communities could identify with, extend and evolve to represent themselves. Built on a site of seven acres, the galleries are raised above the ground on columns, forming a continuous, multi-level verandah, following the contours of the sloping, rocky terrain. The structure is built with steel tubes, castellated girders and steel rods fabricated into intricate trusses. Steel seemed to be a natural choice in the land and location of ancient iron and bronze-age civilizations, and the contemporary truck body building industry. The walls use both local stone left exposed and brick plastered, with crushed stone on the outside and mud plaster on the inside. The roofs are made of half-round tiles, galvalume sheets and concrete with a topping of grass and groundcover.

buildings that comprise the western elevation which serves as a backdrop to the crisscrossing steel structure that unfurls like a tree from columns in front of this elevation. It rises to around a 20m height and folds down around the space. It spans 150m in length and has become Europe’s largest single span station structure, comprising of 16 steel tree form columns that radiate from an expressive, tapered central funnel.

LOOKING TO THE FUTURE

As for the future of the material in the country, experts seem to have varying degrees of confidence with regards to its progress. Citing issues of poor technical knowhow and lesser acceptance in the market to lack of knowledge of the material’s capabilities, steel, even with its proven competence, finds lukewarm response in the country. “At the moment, we use a variety of shapes, welded together, to achieve complex functional needs,” explains Kamath. “It would be productive if the industry worked with us to evolve a variety of products to suit (different) functions.”

Notes Shroff: “The architecture and construction industry in developed nations has moved towards steel-intensive structures. It is high time now to introduce steel-specific curriculums in academia. This would bring about a major paradigm shift in the industry.” Since it is a sustainable construction material, he would like all stakeholders to come together and make a concerted effort to promote steel.

“Diligent use of steel can actually add to the impact of a sustainable building, as it reduces the overall structural load and controls material consumption in quantum amounts,” maintains Patel. “The percentage of steel used in a structure has come to determine how eco-friendly a building is; it is certainly a quality material for the construction industry.”

Concludes Iyer: “Steel is not a forgiving material. Errors and blemishes cannot be hidden like in other structural systems. Steel, in conjunction with 3D panels, cement sheets and deck slabs as a family of structural systems, in my opinion, has great potential. For steel to be widely accepted into the Indian design language, it has to be made more approachable as a material. The skills to handle, fabricate, install and finish a steel component have to be propagated.”

While the country still ponders over the use of steel, the global advancement in steel continues with steady acceleration. Iyer envisages that the construction of a self-sustaining arcology in the near earth orbit would be an impressive statement made by the prowess of this versatile material. ■