

# STRUCTURES TO BE IDEALLY MADE IN STEEL

INSDAG'S PERSPECTIVE

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## A. New Areas of applications to be encouraged in India

### 1. **Road Bridges for various spans up to 50M should be in I-Girders or box-girders (Steel) and above 50M should be trussed bridges (Steel)**

#### Facts to be considered

- For various spans up to 50M should be in I-Girders or Box-girders, both in urban as well as also in high-way flyovers.
- Trussed bridges above 50m in Highway flyovers.
- For spans more than 30m, Steel / Steel-concrete composite option might be cheaper than PSC option

#### Global Examples

- **Golden gate Bridge, San Fransisco.** It's a steel suspension cable bridge and it's an iconic construction.
- Modern trend is cable-stayed bridge like **Vidya Sagar Setu** over River Hooghly and Extra-dosed bridges like **Nivedita Setu** over River Hooghly are the norm of the day.
- Trussed Bridges--- **Brooklyn Bridge** in New York is a hybrid Cable Stayed/Cable suspension bridge.
- Rajahmundry Road-cum-railway bridge, the iconic Rabindra Setu (Howrah Bridge) are Indian examples of trussed bridges in India.

#### Major Hindrances

- High grade concretes up to M60 grade have become common in India for Prestressed Concrete Bridge Girders. IRC: 112 allows use of Concrete up to M110.
- The availability and provisions of higher grades of concrete coupled with the availability of Low Relaxation Prestressed Concrete cables up to 320 KSI has made use of these type of girders very popular for not only urban fly-overs but also highway over-bridges.
- Life Cycle costing is not considered while deciding the material of construction as to whether to go for Steel or Concrete.
- Concessionaires are responsible for up-keep of bridges for 15/20 years only.
- Professionals are more familiar with designing and construction of Concrete bridges than Steel bridges.

### 2. **Continuously Reinforced Concrete Pavement (CRCP) for High rainfall and inaccessible stretches (low maintenance), Tunnels**

- CRCP is an asset for heavily traveled high-speed roadways. The excellent service of CRCP pavements is reflected in the following significant operational features:
  - a) Joint less concrete pavement---- CRCP offers excellent smooth riding surface for the vehicles that maximizes the comfort for the passengers

- b) CRCP is more durable, which can last 40-50 years without much maintenance problem during the life of the pavement. Concrete actually hardens over time. After its first month in place, concrete continues to slowly gain about 20% strength in first 12 months.
- c) It needs minimal cost of maintenance and rehabilitation
- d) Considerable Savings in fuel, may be considered, ultimately reducing the vehicle operating cost.
- e) Concrete roads facilitate increased speed and thereby savings in time and money. Almost maintenance free service and reduces traffic disturbances and thus reduces man-hour loss to the road users.
- f) Refer Tambe Committee report 2016

#### Global benchmarks

- a) CRCP is the most preferable option for long-term pavement solutions and in some countries like Belgium there is a government directive to go in for only CRCP for all motorized roadways.
- b) There are number of projects of Continuously Reinforced Concrete Pavement (CRCP) has been built in the U.S (more than 28000 lane-miles of CRCP is used in Illinois, Texas, South Dakota, etc.

#### Note:

- INSDAG has already done lot of studies on this.
- Proper marketing of the concept needs to be concentrated on.

### 3. Tall Buildings above 25M height (above 8 stories)

#### Facts to be considered

- More column free space
- Better stability against seismic activity
- Much faster completion time giving early return for capital invested
- Long life period (over 100 years)

#### Global Examples

- **Empire State Building:** First of its kind built in 1930-1931 in New York, USA. Uses granite, Bricks, concrete and steel.
- **Burj Khalifa:** Built in first decade of 21<sup>st</sup> century and opened in 2010. Height is 829 meters. Combination of steel and RCC both in foundation as well as in framing system.
- Numerous other Tall buildings overseas

#### Major Hindrances for construction of tall buildings

- IS Code for tall building has been published recently for RCC buildings (IS: 16700 – 2023), but for steel building the code is under preparation by the CED-38 committee.

- Life Cycle costing is not considered while deciding the method of construction-Steel or Concrete, though some studies have indicated that steel-framed structure have lesser life cycle cost than RCC framed structure
- Professionals are more familiar with concrete designs and hence comfortable with Concrete designs, detailing and construction, rather than Steel.

#### 4. Medium height buildings like shopping malls and office complexes

##### Facts to be considered

- More column free space
- Much faster completion time giving early return for capital invested
- Composite construction is slowly getting acceptance in India for construction of large shopping malls
- Cold-formed steel construction may be adopted for midrise buildings (up to 7 storey)

##### Global /Indian Examples

- **The Shard** in London, a mixed-use skyscraper, utilizes steel extensively
- **Office building of JSWL in Bandra-Kurla Complex** in Mumbai is a landmark structure.
- **Indira Paryavaran Bhawan in New Delhi (3B + G +7 Storey)**: First of its kind built in 21 in New Delhi in 2012. Uses concrete and steel.
- **Handloom Complex in New Delhi (2B + G + 4 Storey)**: First of its kind like the above in India

##### Major Hindrances

- Life Cycle costing is not considered while deciding the material of construction as to whether to go for Steel or Concrete
- Professionals are more familiar with Concrete than Steel.

#### 5. Buildings (above 3 floors) in high seismic prone area like in Zone IV & V

- Main reason is self-explanatory
- Steel is always preferred in Seismic zones than RCC for its attributes

## **B. Areas already using steel but needs further thrust**

### **1. All long span utility structures like terminal buildings, airports, train stations etc.**

#### *Facts to be considered*

- More column free space gives better utility and services
- Long span building like warehouses, airport hangars and even assembly buildings for various industrial and commercial products are already being built in steel, but new buildings should be ensured to be built in steel.
- For Airport and Rail stations, Steel allows for aesthetically pleasing and functional designs, enhancing passenger experience.

#### *Global benchmarks*

- The Airbus A380 assembly plant in France uses steel for its expansive and unobstructed interior.
- Beijing Capital International Airport's Terminal 3 is a large-scale steel structure
- All Major airport new terminals match with global standards as far as aesthetics, and service requirements are concerned

### **2. PEB Structures particularly for Industrial buildings**

#### *Facts to be considered*

- PEB's are very common in India.
- Mostly used for Industrial purposes.
- Not only ensures economic use of steel and other material but also provides the most aesthetic look for an industrial unit.

#### *Global Examples*

- The Mariposa VII-seven-storey multi-family building in Denver, Colorado, USA. It's a Cold formed Steel Building.
- 388 Lonsdale- Eight stories were added to an existing 1970, 12 storeys building in Melbourne's CBD. This was largest CFS flooring cassette project ever
- Light House Projects - Agartala, Tripura in CFS

### **3. Infrastructure Projects (e.g., metro stations, bus terminals)**

#### *Facts to be considered*

- More column free space gives better utility and services
- Aesthetically pleasing structures can be constructed using steel.
- Large column free space can be achieved for better serviceability for which the structure is built.

#### *Global Examples*

- The London Underground uses steel extensively in its stations

- Tokyo Underground network is a technological marvel in Steel

#### 4. Multi-level Car Parks

##### Facts to be considered

- Built, mostly in Concrete in India. Steel framed structure will be light and will ensure faster construction.
- More Column free area is a must for car movement and maneuvering and hence steel structure will ensure better service requirements

##### Global benchmarks

- **Brisbane airport multi-level car park.** It's a combination of steel and RCC construction

#### 5. Food Grain Silos ---- Already in Practice in a limited way by FCI. More to be pursued

#### 6. Steel roofs of large stadiums.

##### Facts to be considered

- Roof structures of big open stadiums for large playgrounds.

##### Global benchmarks

- **The Bird's Nest Stadium** in Beijing, built for the 2008 Olympics, is a striking example of a steel structure.
- **Wembley Stadium in UK.**
- **Fortaleza, Brazil** (redevelopment with steel roof and supporting truss columns)