Bridges of India – Architecture against the Odds

Mains: *GS II – Infrastructure*

Why in News?

Recently the Indian bridges have gained a wide attention for its infrastructural efficiency and engineering marvel.

What is the importance of Indian bridges?

- **Witness of Indian engineering** – Spanning over turbulent rivers, deep gorges, and restless seas, India's bridges stand as silent testimonies to the country's engineering ambition.
- **Tool of connectivity** – They connect not just towns and regions, but people, cultures, and economies, often in places where geography had long dictated isolation.
- Across India, bridges shape everyday life in ways most of us barely notice.
- They shorten distances that once took days to cross, open access to remote communities, and withstand nature at its fiercest.
- **Measuring the vision of infrastructure** – Among the countless bridges that form a vast network throughout the country, several key bridges exemplify the scale and vision of India's infrastructure.
- Each one carries its own tale, of daring design, relentless weather, and the human resolve to overcome terrain.

What are the bridges that define india's connectivity?

- **Atal Bihari Vajpayee Sewri-Nhava Sheva Atal Setu –** Stretching across the Arabian Sea like a bold stroke on the city's canvas, the *Atal Setu*, also known as the *Mumbai Trans Harbour Link (MTHL).*
- It marks Mumbai's biggest step towards a horizon unrestrained by traffic and time.
- It has been developed to ease the heavy traffic burden of Mumbai's island city.
- Built using advanced construction and safety systems, the bridge offers a faster and safer route across the bay, reducing accident risks and improving the daily travel experience for commuters.
- The MTHL has helped boost tourism in Mumbai and nearby regions, while also enhancing connectivity for trade and industry, contributing to the growth of the local economy.
- Spanning *16.5 kilometres over the sea* and extending another *5.5 kilometres on land,* and stands as *India's longest sea bridge.*
- Even amid the unprecedented challenges posed by the Covid-19 pandemic, the project

managed to stay on track and meet its planned deadline.

- **Chenab Bridge –** India's engineering prowess has reached a new pinnacle with the completion of the Chenab Bridge, *the world's highest railway arch bridge.*
- It has been hailed as a testament to the brilliance and commitment of the country's engineers and workers as the project confronted hurdles.
- The Chenab Bridge *rises 35 metres higher*, positioning itself not only as a vital infrastructural asset but also as an emerging tourist landmark.
- Perched *359 metres above the Chenab River*, the bridge forms a crucial segment of the *Udhampur–Srinagar–Baramulla Railway Link (USBRL).*
- With Vande Bharat trains set to operate on the route, travel time between Katra and Srinagar will reduce to just about three hours.
- The *1,315-metre-long steel arch* structure has been designed to withstand wind speeds up to *260 kmph* and built with a projected lifespan of 120 years.
- The Chenab Rail Bridge stands as a symbol of India's ambition, technical excellence, and advancing infrastructure capabilities.
- **New Pamban Bridge –** The newly constructed Pamban Bridge, connecting Rameswaram with the mainland, *is India's first vertical lift railway sea bridge.*
- It has emerged as a standout symbol of modern Indian infrastructure on the world map.
- The *2.07 km* structure includes a *72.5-metre vertical lift section that can rise 17 metres, a*llowing ships to pass safely without halting train movement.
- The new Pamban Bridge's construction encountered major environmental and logistical challenges, including turbulent waters, strong winds, cyclones and seismic risks, and the difficulty of transporting heavy materials to the remote site within tight tidal windows.
- Through innovative engineering and advanced technology, over 1,400 tons of fabrication, lift-span launches, 99 girders, and extensive track and electrification work at sea were completed *with zero injuries*.
- Crafted with stainless reinforcement, high-performance protective coatings, and fully welded joints, the bridge promises greater longevity and lower upkeep.
- It has also been prepared for future growth, with space for a second railway line.
- A specialised polysiloxane finish shields the structure from corrosion, an essential safeguard given the demanding coastal conditions.
- **Dhola–Sadiya Bridge –** The Dhola–Sadiya Bridge, also known as the *Bhupen Hazarika Setu*, is a vital link between *Assam and Arunachal Pradesh.*
- It provides the first permanent road connection between northern Assam and eastern Arunachal Pradesh.
- Built as a beam bridge, it sweeps over the *Lohit River*, one of the Brahmaputra's major tributaries, connecting Dhola in Tinsukia district to Sadiya in the north.
- Stretching *9.15 kilometres*, it is built to withstand the load of 60-tonne military tanks, including the Indian Army's Arjun and T-72 models.
- This capability adds significant strategic value to the structure.
- **Anji Khad Bridge –** The Anji Khad Bridge pierces the Himalayan landscape with an elegance and scale unmatched, emerging as *India's first cable-stayed railway bridge* and a key link in the *Katra–Banihal section of the Udhampur–Srinagar–Baramulla Rail Line.*
- Located about 80 kilometres from Jammu and set against snow-capped peaks, the

bridge soars *331 metres* above the Anji River valley and extends *725 metres across the gorge.*

- Its defining feature is an inverted Y-shaped pylon *rising 193 metres* above its foundation, supported by *96 high-tensile cables.*
- More than *8,200 metric tonnes* of structural steel reinforce the bridge, enabling it to withstand seismic activity.
- The Anji Khad Bridge was built through extremely rugged Himalayan conditions marked by cherty limestone formations and unstable hill-wash debris with large limestone boulders.
- To protect the mountain ecology, extensive *slope-stabilisation measures* were implemented throughout construction.
- Beyond its technical sophistication, the Anji Khad Bridge stands as a symbol of persistence and vision, with completion in just 11 months.
- As part of the broader rail link connecting the Kashmir Valley with the rest of India, it is set to improve travel efficiency, enhance regional connectivity, and unlock new economic opportunities.

What lies ahead?

- India's bridges are more than infrastructure; they are statements of intent, connecting a nation defined by scale and contrast.
- They rise from mountainsides, pierce through monsoon clouds, and skim the surface of some of the subcontinent's most volatile waters.
- Through every corner of this vast terrain, various bridges continue to reflect India's drive and determination.
- In their shadows lie stories of innovation, perseverance, and the complex landscapes they dared to conquer.
- They reshape economies, redraw maps, and reimagine how people move, live, and dream.
- Each new span reflects not just engineering progress, but the nation's willingness to push beyond the limitations of region, time, and history.
- As India continues to grow, its bridges will remain among the clearest expressions of a country in motion, always reaching forward, always building its own path.

References

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