



# SPAN OF CONTROL

Bridges and flyovers dot metros and smaller cities too. But construction methodology varies

BY Molly R

**B**ridges and flyovers in India become landmarks. If you want to give anyone directions, they are best described by the nearness of a bridge or flyover.

Bridges are of various types. Construction of these structures depends upon location, budget, its use, among other things. Suspension, masonry, arch, steel deck, pylons, cantilever, concrete, are only some of the common ones seen in India.

**Akhil Gupta, executive director, operations, Afcons Infrastructure**, says, "The success of any engineering project depends on complete understanding and co-operation among various stakeholders involved in the project. Involvement of local people, administration and sensitising them about the need of the project and benefits that accrue to the local economy are always kept in mind. We look at opportunities to bring improvement in design and aesthetics of bridge and work closely with consultants, clients, environment agencies while working on any project."

For Afcons, from capturing stakeholder expectations and translating into constructible drawings, to designing for ex-

treme engineering, its teams come together to become a dependable force to match ambitions of the organisation and clients alike.

Ranked 13th globally in construction of bridges, Afcons has executed some prestigious projects like Mahatma Gandhi Setu in Bihar, Chenab rail bridge, Vallarpadam rail bridge (Kerala), Ram Jhula bridge (Nagpur), among others.

However, Gupta keenly takes up the cause of contractors by saying, "One important aspect we would like to highlight is making the EPC contracts fair to the contractors, which is not the case at present. More often than not, the scope of work is not defined clearly and contractors are expected to execute additional works without compensation. Completion time for investigation, survey and design should be separate from scheduled construction time due to complexity of the project," says Gupta.

Recently, Nagpur got an infra boost with the country's first multi-layer transport system with Metro Rail at the top and an elevated highway below it. Supported on a single integrated pier, the 3.15km long double decker bridge is a new



## THE ART OF BUILDING BRIDGES

**Akhil Gupta, Executive Director, Operations, Afcons Infrastructure, offers a profound understanding on building remarkable bridges/flyovers**

### **How different are construction of bridges/flyovers in different locations across the country?**

Each bridge is distinct and unique. Bridges and flyovers are engineering structures and require extensive understanding of local geographical/geological conditions. Bridges in Himalayan geography have different challenges as the mountain is young and fragile and prone to landslides. Construction of projects in Jammu & Kashmir, Himachal Pradesh and the North East poses extremely different challenges due to very hostile topography and weather. Construction of foundations in strata with boulders is unique and selection of foundation in such strata becomes tricky.

Constructing pile foundations is very difficult in strata with boulders and excavation for open foundation also is challenging if foundation depth is large. Well foundations have been executed in such strata but takes long time to complete. Normally in hilly areas over deep gorges, large spans have to be constructed over long piers which require special techniques like cantilever construction of superstructure and slip forming of tall piers. Accessibility, availability of materials, manpower deployment and logistics are other hurdles in such areas. In addition, there are issues of stability of slopes due to landslides if the bridge is constructed close to hills.

Bridges across perennial rivers require deep foundations having depth of 40 to 50m due to scour and liquefaction considerations. It is difficult to construct well or pile foundations in running rivers where water depth is substantial. Islands are constructed where water depth is shallow. However, in deep water depth, floating caissons are used for construction of well foundations. Barges/jack up platforms are required for piling. Cranes, concrete pumps and other equipment are transported on heavy barges for construction of foundations

and substructure. Superstructure is constructed either with cantilever construction or launching of spans. Each project demands extremely good understanding of equipment required to be deployed and suitable for deep water construction. Where navigational spans are required, which are becoming quite common in our country, piers and foundations have to be protected against collision of barges by providing a suitable fender system.

Flyovers and viaducts in urban environment pose a different kind of challenge - the biggest being working in a congested environment. The availability of space required for construction is limited and generally a narrow strip of land along the length of flyover/viaduct and traffic has to keep moving on diversion roads on sides. There are large number of utilities which need to be shifted within a tight time frame. Construction in such an environment poses safety risk for those working as well as to the public at large. Precasting of superstructure is almost a must in urban environment which requires casting yards for casting of precast units. Transportation of such units weighing anything between 20 MT to 200 MT to the site of construction is another hurdle and is normally done during night when traffic is less.

### **What is the kind of equipment required to construct them?**

While some standard equipment may be common to construct different types of bridges such as piling equipment, cranes, barges, concreting equipment etc, many bridges require deployment of specialised equipment and construction scheme specially designed for a particular bridge. For example, in case of Chenab Bridge in Jammu & Kashmir which is being constructed at 359m the riverbed, we have deployed world's tallest cable crane across the Chenab river to handle erection of specially fabricated heavy structural steel elements for steel arch bridge. This cable crane can lift 34 tons of weight on a single hook. This facility was established well

before start of any major construction activity of the project. Similarly, launching of superstructure of large span bridges in deep valley require tailormade scheme and technology to launch superstructure at a height of 100m or more.

In some of the bridges in Jammu & Kashmir, we have developed a specialised launching scheme through push launching of major bridges of 500m to 800m length. Erection of superstructure by cantilever method in river bridges of large span structural steel trusses is frequently used.

Afcons has inhouse capability and expertise to modify and customise equipment and machinery for its unique and complex projects. Take Chenab Bridge for example. The main span of the bridge rests on a 469m-steel arch, whose erection is most critical owing to the intricate design and geometry. In a first, perhaps worldwide, incremental launching has been done on a transition curve as the deck is partly in straight, partly in a circular curve, and, partly on transition curve.

Large capacity hydraulic piling equipment are required to execute large diameter piles up to 2.5m urban flyovers.

For well Foundations, apart from grabs and cranes, jacking up equipment may be required for well sinking. Launching girders are required for erection of precast segments. Slip form and jack up formwork are required for construction of tall piers.

**Considering that these projects are from design to construction, how would you look at design to enhance the topography of the place?**

Normally, the projects scope does not include development of topography of the place. However, landscaping of the surrounding area wherever possible and if included in scope can be taken up. Slope protection of hilly terrain is carried out to enhance topography of immediate area.

The scope of work should include enhancement of the topography with clear-cut stipulations so that necessary landscaping and beautification of the areas in immediate vicinity of the structure is taken up.

**What are some of the new technologies/innovations in construction of bridges/flyovers? Globally, some of the bridges make the area a landmark, how can India work on that?**

Several landmark bridges have been constructed in India by Afcons. We are currently constructing single arch bridge of 469m span across Chenab River in J&K. The bridge once completed will be the highest single arch rail bridge in the world. This will be a landmark bridge and can always be de-



“WE LOOK AT OPPORTUNITIES TO BRING IMPROVEMENT IN DESIGN AND AESTHETICS OF BRIDGE.”

AKHIL GUPTA

veloped as a tourist hub.

In our country, new technologies include construction of extradosed and cable stayed bridges that are becoming common. Several such bridges have been constructed in our country. These are being constructed not only over large rivers but also in urban areas.

In majority of such structures, international design consultants are involved for design. Development of design consultants and skilled manpower requires to be taken up to reduce dependence on international expertise.

The Mahatma Gandhi (MG) Setu, in Bihar, has become the first PSC balanced cantilever bridge in India where PSC Balance Cantilever superstructure has been replaced with simply supported structural steel through truss, while retaining foundation and partial substructure. This 5.56km long bridge now gives an aesthetic look. The project was envisaged by MoRTH. The engineering standards earned praise from Nitin Gadkari who hailed the project as “an engineering marvel” and a “lifeline” for the masses. He said the technological research for MG Setu will be a case study for other complex bridge projects.

The ROBs in the Firozabad-Etawah sector of Agra-Lucknow Expressway were challenging. ROB 67, which had to be constructed over the busy Delhi-Howrah rail route, had an abnormal skew of 460. It was the first ROB of its kind, and upon completion, it became the heaviest steel truss (1530 MT) across railway tracks in the country. Afcons resorted to push-launching methodology by erecting the total structural steel on an adjacent span and push-launched it over running Railway line.



▲ Case India has advanced machines for infrastructure building.



MOST OF THE BRIDGES ARE CONSTRUCTED WITH LARGE VOLUMES OF CONCRETE OR STEEL, AND INVOLVE LESSER VOLUMES OF EARTHWORK.

SANDEEP MATHUR

landmark.

Similarly, Dilip Buildcon is constructing the new cable stayed bridge over the river Zuari.

**STRONG BACKING**

After design and engineering, equipment plays a critical role in construction. **Dheeraj Panda, director, sales, marketing and customer support, Sany Heavy Industry India**, says, "Wear and tear inevitably occurs in equipment during construction at challenging sites. It's a slow process caused



▲ Earthworks form a large part in the initial stage of construction.

over a significant period of time due to stressful events. Extensive operations and pushing equipment too hard on the rugged terrains may lead to wear and tear in the equipment, like breakage & chip off, lubricant leakage, hydraulic and electrical failure, etc. Sometimes digging tools take massive hits and spokes, etc. get broken. Glitches in construction equipment can also be influenced by outside factors like weather, application, storage condition, and maintenance, which can place additional stress on equipment."

Challenging projects usually have short deadlines or high production requirements to meet, as a result of which the



▲ Sany India has numerous equipment that can work on projects every step of the way.



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DHEERAJ PANDA



“USING SPECIALIST PRODUCTS SUCH AS KAMOPRIME ZINC CHROMATE PRIMER PROVIDES UNIFORM LEVELLING, FAST DRYING AND PROTECTION.”

SAURABH AGARWAL

machines are used extensively. **Sandeep Mathur, brand leader, Case Construction**, says, “Most of the bridges are constructed with large volumes of concrete or steel, and involve comparatively lesser volumes of earthwork. In order to ensure the safety and efficiency of a machine in challenging environment, we have incorporated systems like Eagle-Eye telematics with GPS tracking that helps in monitoring the machine and relays real-time alarms related to fuel, battery, coolant temperatures, etc. We also offer Case Care & Case Protect Programmes which are designed to monitor machines regularly and proactively advise machine owners and perform periodic maintenance when required.”

Similarly, to make them long-lasting, bridges and flyovers using steel and iron as key structural components need to be well protected from formation of rusts. **Saurabh Agarwal, director, Kamdhenu Paints**, says, “A specialised oil based paint is used on such surfaces to ensure a rust free surface and to reduce the impact on wear and tear on them. Using specialist products such as Kamoprime Zinc Chromate primer provides uniform levelling, fast drying and long and durable protection to the substrate thereby ensuring a longer life span. Products such as the Kamoprime lustre aluminium paints provides excellent protection against the formation of rust to exposed aluminium structures.”

The significant reduction in Volatile Organic Compound (VOC) content in paints has made it environment-friendly. Significant advancements have also been made in improving adhesion properties of primers and top-coats.

Overall, with the government stressing on creating better infrastructure has been focusing strongly on projects that will only better the lives of citizens while bringing in foreign investments into the country. Bharatmala Paryojana is in full swing building roads, highways, expressways, bridges and flyovers. **CW**