A SUCCESS IN IMPLEMENTATION OF A DREAM

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enters Bangladesh at Kurigram. From this point onwards it continues as the Jamuna and finally discharges into the Bay of Bengal along with the Padma & the Meghna. In 18th century it was simply a branch of the Brahmaputra river and changed into main flow after a natural disaster (earthquake and flood) and passing almost straight to the south with an average discharge of about 19,500m^3/sec, which is the 5th largest among the rivers of the world.

Selection of Location

The design and construction of a bridge across a river involve many factors. The location of the bridge is determined on the one hand by economic consideration in respect of construction cost & Internal Rate of Return (IRR) and on the other hand by river engineering issues. During feasibility study, seven locations were considered, from Bahadurabad at upstream to Mawa on the down for selection of site. Among these, a crossing

Railway tracks on the Bangabandhu Bridge

has been found suitable at 8 km down of Sirajgonj in all respects. At this location the river was flowing within a single and narrow channel (about 5 to 6 km) for the last couple of decades, without any major erosion on the banks. At about 10 km upstream it has an erosion-resistant clay bank on the east which prevents the river to move further to the east and deflects the currents towards contor of the channel. At the same time River Training Works for Sirajgonj Town protection are providing the same on the west bank. Moreover a 5 m thick Gavel Layer at an average 75 m depth below the river bed on this corridor is giving an additional support for the foundation of the bridge.

The Project

JMBP is the biggest ever constructed project in Bangladesh having multipurpose provisions for Road and Rail communications, Power Supply Interconnector, Gas Transmission Pipeline and Telecommunication facilities. At the cost of US$ 970 million the project has been organised in both ICB & LCB contracts having components for construction of Main Bridge & Approach Viaduct, River Training Works, Approach Roads and Flood Embankments.

In addition to constructional elements, JMBP has some important and interesting components in the fields of social and environmental sectors. The inclusion of these programmes are new concept and first time in our country. Under these programmes, there are provisions for resettlement of the project affected people whose professional life and business have been determinate due to acquisition of their land and house steads, protection of environment of the locality during and after completion of construction works, protection of wildlife, mitigation of fisheries, protection of changes in cropping pattern and also compensation of the people who will be affected in future by Erosion & Flood in the down and upstream of the project.

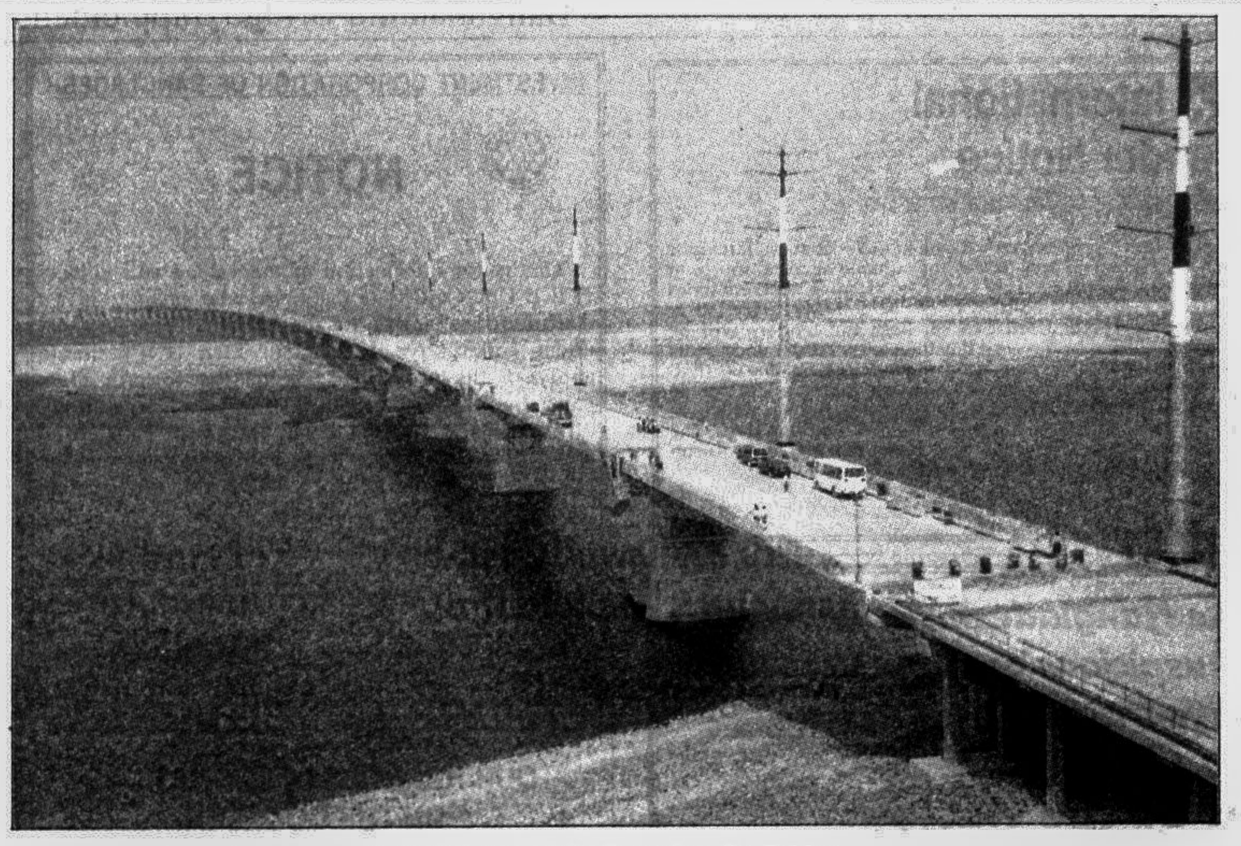
Since the programme for construction of a bridge over the Jamuna river was a professional challenge, the responsibilities for its design, construction and supervision as Engineer of the project have been entrusted to Rendel Palmer & Tritton-NEDECO-Bangladesh Consultants Ltd (RPT-NEDECO-BCL) a group of experienced and internationally renowned consultants. They have conducted the Engineering & Economical studies, prepared the Engineering Design and tender documents and finally supervised the construction works as Construction Supervision Consultant (CSC) of the project. There is also a Management Consultant (MC) to assist JMBA to ensure the performance of CSC and the Contractors of the project. In addition to these arrangement a group of internationally renowned engineers (local & expatriate) having well known experience and knowledge in the field of bridge, river training and environmental engineering have assisted JMBA as Panel of Experts (POE).

Construction of JMBP started in October, 1994 when 4 main contracts (ICB) of the project were awarded to different internationally reputed Contractors. First of all at three locations of project area, construction facilities have been developed with provisions for plants, equipments, storage of materials, yards for construction including accommodations for the personnel responsible for construction & supervision. Of these establishments, the main one is just on the east end of the bridge alignment where a Work Harbor with jetties have been constructed for operation of offshore construction works. Contractors mobilized their manpower, plants & equipments, construction materials and technologies from all over the world having global participation. The physical construction of JMBP has been started on October, 1995 with the ceremonial ground breaking of all the 4 major Contracts of the project.

Construction of Main Bridge and Approach Viaducts

The main feature of JMBP, is construction of 4.80 km long world's 11th longest bridge over the Jamuna river, which has been named ***Bangabandhu Bridge***. It's a Pre-stressed Box Girder Concrete Bridge inclusive of 2 Viaducts each of 128 meter length on either end, having 18.50m wide deck, with provisions for 4 lanes for Road Traffic and a lane for Dual Gauge Rail. Hyundai Engineering & Construction Co.-JV a reputed construction firm of South Korea was responsible for construction of this bridge (Contract-1) at a cost of US$ 247.40 million (Tk. 986.93 crore). This bridge has a speciality over other bridges so far built in our country. Most of the concrete elements of this bridge are pre-fabricated and pre-cast structural units, manufactured in yards and assembled together to build the entire bridge structure. The bridge has been designed for a 100 years life and provided with seismic devices to absorb an earthquake shock up to 7.0 Richter Scale.

For construction of Bridge & Approach Viaducts, Hyundai Engineering & Construction Co.-JV (HDEC) have engaged all efforts by mobilizing manpower and technology, plants and equipments and gathered materials from all over the world. HDEC set up about a kilometer long construction yard with all facilities for production of pre-cast components of the bridge, storage of construction materials, water treatment plants, fabrication of reinforcement bars, storage of finished products, laboratory, office facilities etc. It's a "Turnkey Project" inclusive of design and quality assurance of the completed works. HDEC have engaged the world renowned Engineering & Consulting firm T Y Lin International (USA) for the structural design of the bridge.



A partial view of the Bangabandhu Bridge

Structurally the bridge has a Pre-stressed (Post-tension) Pre-cast Segmental Progressive Balanced Cantilever Box Girder Superstructure supported by Reinforced Concrete Substructure having deep foundations with Steel Tubular Racking Piles filled with Mass Concrete. The Viaducts are of RCC Deck Slabs resting on Cross-Beams supported by Pre-cast Columns having Pre-cast Pile foundations. The Main Bridge has 49 spans each of 99.375m length exclusive the two End spans each of which are of 66.6875m. In the foundation of the bridge at 50 locations, a total 121 no. Steel Tubular Piles in cluster of 2 or 3 nos. at each location having 3.15m & 2.50m outer dia (with 60mm to 40mm wall thickness) have been driven at an average 72m depth below the river bed. The giant size piles were being manufactured in pieces of 40 to 49m length. The bridge has been provided with a horizontal curvature of 12km radius, convex to the north to divert the light hazards from Locomotives.

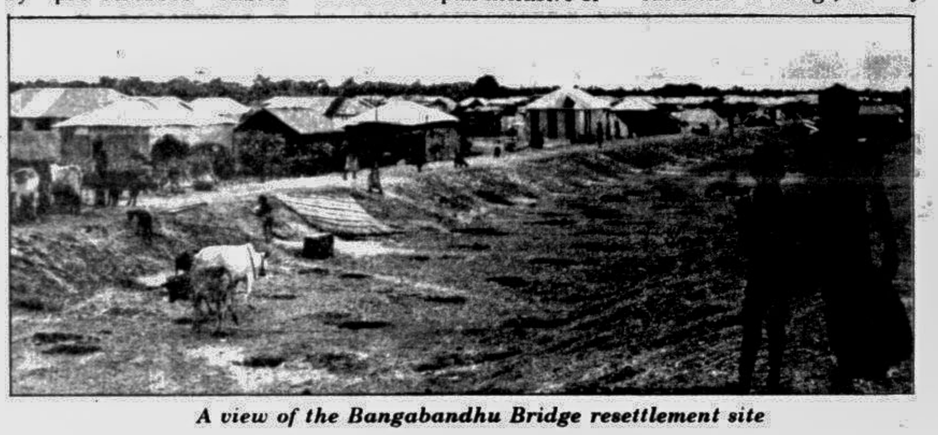
The sub-structure of the bridge comprises Tubular Steel Piles, Pre-cast Pile Cap Shell, In situ Piers. The pile driving operations were done by a gigantic and well equipped offshore pile driving barge having a 1000 ton capacity crane. A double operative hydraulic hammer having 210 ton self weight was specially manufactured for this bridge. The hammer could produce a maximum of 1700 ton meter energy per blow, of which 1400 ton-meter has been required to drive the piles. For fixing the alignment and foundation location, both TOPO Survey by total station equipment on ground and DGPS through satellite station have been used. First of all, a platform was fixed on the river and then a Jig Jacket was placed in accurate position to keep the pile in correct rack (1:6). To build the full length of pile one piece was driven first then another one was placed on it and welded together and driven at least 1m inside the gravel layer underneath the river bed. Once the piles were driven, the soil inside was removed by Air-lifting (blowing air by compressor & forcing out the spoil by high pressure water jetting) keeping soils only 2 dia length of pile at the toe. The entire length of the piles have been filled by concrete and subsequently through porous steel pipes gaps/voids (if any) at the bottom were filled by pressure cement grout. Shear Keys are being provided at 3 different levels inside the piles and also on the outer surface at the top. A 10 meter high and about 250 to 280 ton weight Pre-cast Pile Cap Shell were placed over each cluster of pile (3 or 2) on which in-situ Pier Stems were constructed by in filling the shells.

Each intermediate span of the bridge has 25 Pre-cast Segment Units and the bridge has a total 1263 nos. of Segment for its 4.80km length of which only 49 nos. are in-situ. The pre-cast segment units being manufactured in nine cells closed off by curtains, produced one after another by match casting and their curing were accelerated by the use of steam at 45^{0}C for a period of 12 to 14 hours. Each segment of the super-structure is 4m in length with 18.50m wide deck exclusive of the Pier Head Unit (PHU) which is 2m in length with extended cantilever for supporting of Pylons. The depth of the segment units varies from 6.5m (PHU) to 3.25m (std. one at mid span) and their weight also varies from 175 to 120 ton (heaviest one is PHU). Though the pre-cast segment units are similar in shape but they are not geometrically identical since the bridge has a horizontal curvature of 12km radius and also a vertical grade of 0.25% (at centre spans 0.05%) including a transverse cross fall of 2.5%. After manufacturing of the segment units they were being kept at yard for 28 days for natural curing and transversely stressed prior to lifting for erection.

For erection of superstructure, a special Gantry has been designed and manufactured in UK. It's a 600 ton weight and 210m long steel structure which travelled over the bridge piers ahead of segment placing and pre-stressing. It posses two overhead hydraulic cranes for lifting and placing of segment units in proper position. During erection of spans, a Pier Head Unit (PHU) is being positioned first on bearings fitted on the Pier Head, the Gantry took its position covering three piers keeping the erected PHU at centre. The immediate two standard segments (west & east of PHU) were being placed, faces were pasted with "Epoxy", stitched together by pre-stresses cables passing through the selected ducts on the deck and stressed by Hydraulic Jack. Then next set of 2 nos. Std. Segment were being placed, stitched all together (5 nos. segments) and stressed in the same manner. In this way the erection of a span with 25 number of Pre-cast Segments (12 std. units on each side of PHU) are being completed. During erection of spans, there remained a gap of about 0.5 m in between two approaching cantilevers which was the only in-situ segment work on the bridge super-structure and is called stitching segment. After completion of erection of all the segments of a span inclusive of concreting of stitching one, the Gantry moved ahead for erection of the next span. Completing a few number of spans, keeping the stitching segment at center longitudinal pre-stressing at the bottom slab of the Box Girder were being conducted similar to that of bridge deck up to segment no. 4 on each side. Subsequently, all pre-stressing ducts including the ducts for temporary pre-stressing were being filled by pressure grouting with cement mortar to protect tendons from oxidations. From segment yard all pre-cast segment units were being transported very carefully by multi-wheeled transporter over the built up bridge deck, which had created an opportunity of physical load test of the bridge since it had produced a resultant live load of about 210 ton (transporters self weight 35 ton) on the bridge deck and the bridge will never carry any load of such magnitude in its life time. There are provisions of six expansion joints on the main bridge to accommodate longitudinal movement. The bridge deck has been furnished with pre-cast parapet units and illumination post and the power transmission pylons are being marked with multi-color paints as air-traffic signal including navigation signal light.

Jamuna Multipurpose Bridge Project has created a significant importance in world wide Civil Engineering construction. The bridge is being built with heaviest and deepest Steel Tubular Piles. Under this project, world's longest Guide Bunds (about 3.2 km long in banana shape on each end of bridge) heavily protected slope protection works have been built to control and guide the 15 km width braided courses of the world's 5th largest river. Slope protection works of this magnitude and design have never been constructed elsewhere in the world. Hundreds of Engineers and Experts from home and abroad both under contractor and consultants have worked together for the challenging construction of Bangabandhu Bridge. Under their guidance, thousands of supervisors and workers have done brilliant performances in conducting the construction works. They worked round the clock with highest degree of skillness with records of 2.8 days time for production of segments and 6.8 days time for erection of a 100 m long span. Most of these working forces were local recruits.

Completion of JMBP will produce major economic benefits for Bangladesh in terms of creating the first fixed crossing link between the eastern and western parts of the country. It will uplift the socio-economic condition of people of the western area of the country, by improving the transportation and marketing of their agricultural products and fruits. Transmission of Natural Gas and Power Supplies will enhance the setting up of industries with new avenues and scopes for employments and thus will help turning-out the poverty. JMBP will also open a new sector for earning revenue by allowing international traffic as a part of Asian Highway and Trans-Asia Rail Route.



A view of the Bangabandhu Bridge resettlement site

Message

From Page 21

since the completion of the JICA study. We saw that the GOB was particularly enthusiastic for the formation of this project. After a series of intensive discussions with the GOB and other donors, OECF decided in 1994 to respond to the request from the GOB to finance 21.5 billion yen (7.5 billion taka) for the project in a co-finance scheme with the World Bank and the Asian Development Bank. A Japanese contribution to the project was made also in the form of technology through an international panel of experts.

The construction of the 4,800m bridge was unprecedented in Bangladesh. It cost about 733 million US dollars (29 billion taka) of investment and took almost four years of time. The bridge is also one of the longest in the world. From the viewpoint of OECF, it is the largest bridge project ever financed in our 30 years experience of development assistance. We believe that the opening of this bridge will facilitate commerce and human interactions between the east and the west of Bangladesh, promoting economic development and national integrity of the country.

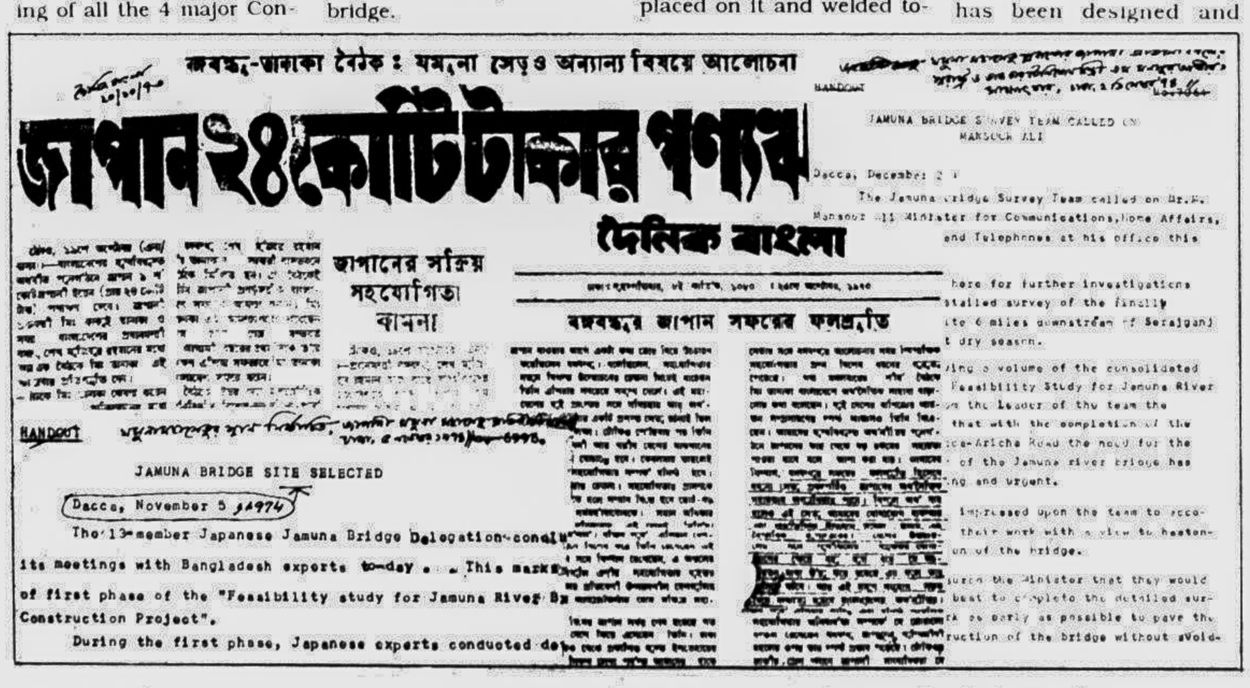
During the course of the project, the GOB, Jamuna Multipurpose Bridge Authority (JMBA), the executing agency, the consultants and the contractors had to overcome numerous difficulties. This project was not only technically challenging but also socially and environmentally sensitive. Environmental impacts and the process of residents' resettlement were closely monitored by NGOs and independent experts. The successful completion of this project would never have been achieved without their devoted efforts.

While the bridge has just been opened, we are already working on the next project to repair and upgrade the eastern main access road that stretches from Dhaka to the Bangabandhu Jamuna Bridge. To optimize the utilization of the bridge, other infrastructures such as railways, telecommunications networks, transmission lines, and gas pipelines will also be built along the bridge in the near future. This "multipurpose" bridge is expected to give impetus to the socio- economic development in the western part of Bangladesh.

OECF has provided yen loans to a total of 62 projects in Bangladesh since 1974. The cumulative loan amount reached more than 500 billion yen (about 180 billion taka) at the end of the Japanese fiscal year 1997 (March 31, 1998). We have also been involved in private sector assistance, an example of which is KAFCO, an international joint venture of a fertilizer production factory, in which OECF has an equity position. The focus of our assistance has mostly been on the construction of economic infrastructures such as roads, bridges and energy related facilities. Our current emphasis is on infrastructure development along the main corridor connecting Chittagong, Dhaka and Khulna. We believe that the development of economic infrastructures is a prerequisite for achieving the national objective of poverty alleviation through accelerated economic growth. Based on this concept, OECF will continue to support GOB's development efforts through financing economic infrastructure projects.

To conclude, I would like to commend all the people who have been engaged in this endeavor. I am proud to see what we all have achieved. It is our sincere wish that new bridge will contribute to improving the living standard of the Bangladeshi people. I hope that the bridge will also be viewed as a symbol of long-lasting friendship between Bangladesh and Japan.

Kyosuke Shinozawa
President
Chairman of the Board
The Overseas Economic Cooperation Fund



রুদ্ধদ্বার-ঢাকায় বৈঠক : যমুনা সেতু ও অন্যান্য বিষয়ে আলোচনা

জাপান ২৪ কোটি টাকার প্রস্তাব

দৈনিক বাংলা

জাপানের সক্রিয় সহযোগিতা কামনা

বঙ্গবন্ধুর জাপান সফরের ফলশ্রুতি

HANDOUT

JAMUNA BRIDGE SITE SELECTED

Dacca, November 5 1974

The 13-member Japanese Jamuna Bridge Delegation concluded its meetings with Bangladesh experts today . . . This marked the end of first phase of the "Feasibility study for Jamuna River Bridge Construction Project".

During the first phase, Japanese experts conducted de-

HANDOUT

JAMUNA BRIDGE SURVEY TEAM CALLED ON MANSOOR ALI

Dacca, December 2 1

The Jamuna Bridge Survey Team called on Mr.M. Mansoor Ali Minister for Communications, Home Affairs, and Telephones at his office this

here for further investigations stailed survey of the finally ite 6 miles downstream of Serajganj t dry season.

ving a volume of the consolidated Feasibility Study for Jamuna River on the Leader of the team the that with the completion of the ico-Ariche Road the need for the of the Jamuna river bridge has ng and urgent.

impressed upon the team to acco- their work with a view to hasten- on of the bridge.

ured the Minister that they would best to complete the detailed sur- rk as early as possible to pave the ruction of the bridge without avoid-

Some news items, editorials and government handouts published on the Bangabandhu Bridge in 1973 and 1974