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Three 2nd bridges construction and existing bridges rehabilitation under KMG project

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ABSTRACT: In order to cope with high traffic demand, GOB has master plan to widen Dhaka-Chittagong Highway (N1) into 8-lane in Kanchpur section and 6-lane in remaining sections. But, three existing Kanchpur, Meghna and Gumti Bridges are becoming bottlenecks against widening of N1. With JICA-ODA finance, GOB is implementing the construction of three 4-lane 2nd bridges. Three narrow box steel girders monolithic with Steel Concrete Composite slab will be used as superstructure, whereas Steel Pipe Sheet Pile (SPSP) is determined as suitable foundation type so as to resist earthquake load and remain stable against severe riverbed scouring. The existing Meghna and Gumti are PC-box girder type bridges having center hinges and expansion joints. Almost all expansion joints will be removed and the embedded space with hinges will be fixed by filling concrete and placing PC cables at hinge section. Their substructure and foundation will be retrofitted by RC-lining and unified SPSP, respectively.

1 PROJECT BACKGROUND AND ITS NECESSITY

The economic development in Bangladesh maintains a GDP growth rate of around 6 % per annum in the 2000s. More specifically, the adjacent areas along Dhaka-Chittagong National Highway No.1 (N1), the lifeline of economy, contributes approximately one-third (32%) of the nation's GDP and more than one-third (45%) of the nation's industrial sector, while it reaches 33% and 13% of nation's service sector and agricultural sector, respectively. Such trend in economic development of Bangladesh directly impacts on the strong growth in both the number of passengers and freight traffic. Accordingly, the freight traffic has been increasing by 8 times over the last 30 years from 1975 to 2005 and at a rate of 6-7% in recent years at the same pace as the GDP, and the amount of passenger transport has been increasing at about 6.5 times during the same period.

The traffic capacity on the main roads connecting the major cities and metropolitan areas in Dhaka cannot keep up with the year-after-year increase of traffic volume and eliminating bottlenecks of distribution routes has become a pressing issue. On the other hand, damage to roads and bridges is progressively increasing and has restrained traffic, becoming a major issue. Moreover, Bangladesh National Building Code (BNBC) has been implemented in 1993 and the earthquake standards have been raised in 2006; therefore the existing bridges no longer meet the earthquake-resistance standards. Accordingly, rehabilitation and retrofitting of the existing bridges have undoubtedly become a pressing issue.

Since 2008, Government of Bangladesh (GOB) has been widening the all sections of N1 to 4-lanes except existing Meghna and Gumti Bridges. This 4-lane project is one of the projects mostly needed to accommodate the growth in traffic demand over the next 20 years. However, for bridge sections, funds have not been raised, widening to meet the traffic capacity has not been progressed, becoming a critical bottleneck to traffic. Furthermore, the existing Kanchpur, Meghna and Gumti Bridges (Fig.1) were constructed in 1977, 1991 and 1995 based on outdated design standards with the seismic acceleration coefficient of 0.05; however the value has been increased to 0.15 in accordance with BNBC (2006). These three bridges are still further damaged by passing huge numbers of overloaded vehicles, and this situation is bound to go on. In order to handle the situation, in June 2011, the Government of Bangladesh requested to JICA to undertake a Feasibility Study on 'the Kanchpur, Meghna and Gumti 2nd Bridges Construction and Existing Bridges Rehabilitation Project (hereinafter referred to as (KMG Project)'. The overall objective of the Project is:

(i) Construction of Kanchpur, Meghna and Gumti 2nd Bridges to cope with higher traffic demand.

(ii) Rehabilitation of existing Kanchpur, Meghna and Gumti Bridges so as to increase structural stability.

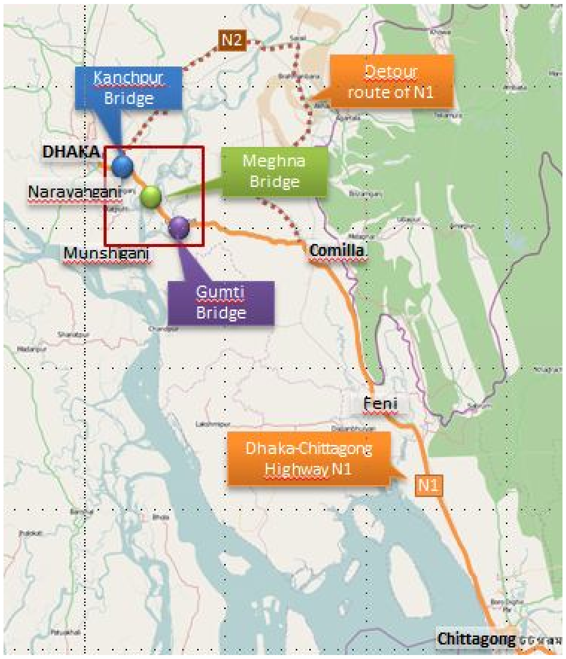


Figure 1. Project Location

2 SECOND BRIDGE ALIGNMENT AND REQUIRED NUMBER OF LANES

2.1 *Bridge Alignment*

In order to select the optimum route alignment for 2nd bridges construction, three feasible alternative routes of each bridge are taken into consideration. These route alternatives for respective bridges are briefly described in Table 1 and they are comprehensively analyzed and evaluated by focusing some key items such as impact on socio-environment and natural environment, construction condition and project cost. It is found that Route A for Meghna, upstream next and parallel to the existing bridge, has minimum resettlement issue and less impact on the natural environment. Therefore, 'Route A' is considered to be optimum route for 2nd Meghna Bridge construction, even though this alignment might have some influence to Holcim Cement boundary. However, this issue has already been resolved by the understanding and agreement between RHD and Holcim Cement administration. On the other hand, the comprehensive evaluation is also applied to optimize route selection for 2nd Kanchpur and 2nd Gumti Bridges construction. Accordingly, the Route A, downstream next and parallel to the existing bridge, is set to as final alignment for 2nd bridges construction.

Table 1. Proposed alignment of 2nd bridges

2nd bridge	Route alternatives	Location to existing bridge	Description of Route
Kanchpur	Route A	Downstream	Next to existing bridge
	Route B	Downstream	Provides adequate distance from existing bridge
	Route C	Upstream	Next to existing bridge
Meghna	Route A	Upstream	Next to existing bridge Minimizes the influence on Holcim Cement boundary
	Route B	Upstream	Provides distance of 250m upstream near the old ferry route
	Route C	Upstream	Provides distance of 250m upstream of shifted ferry route Minimize resettlement issue (Ctg. side) on Route B
Gumti	Route A	Downstream	Next to existing bridge
	Route B	Downstream	Provides adequate distance from existing bridge
	Route C	Upstream	Next to existing bridge

2.2 *Required Lane Numbers*

For the assessment of lane numbers necessary for 2nd bridges, the traffic surveys (traffic count, OD interview, traffic movement count and traffic speed) were conducted in February, 2012 at Kanchpur, Meghna and Gumti Bridge sites (FS Report, 2013). This provides primary traffic data for the analysis of the current traffic characteristics and a basis of the forecast traffic demand of the project. Average Daily Traffic (ADT) at Kanchpur Bridge site is counted as 34,453, while that at Meghna and Gumti Bridge sites is 27,578.

Regression analysis is made using the existing traffic and socio-economic data (vehicle registration data and GDP of Bangladesh) to forecast future traffic demand. Additionally, the traffic demand forecast also considers the influence of traffics to N1 due to development of Dhaka-Chittagong double tracking railway and Chittagong port. The forecasted traffic volume at the Project bridge sites is shown in Table 2 hereunder.

The total numbers of lanes are determined in accordance with forecasted traffic volume and standard road capacity. It is found that at least 10-lanes will be required to cope with traffic volume forecasted in 2030. But, widening of N1 to more than10-lanes is not realistic. Rather GOB has a master plan to develop a toll road connecting Dhaka-Chittagong highway as 8-lanes ahead of Kanchpur Bridge and 6-lanes beyond Gumti Bridge. Therefore, the required numbers of lanes for 2nd bridges are proposed with 4-lanes so as to concurrent with the GOB master plan. Moreover, the lane number of Dhaka-Chittagong Expressway, an alternate route of N1, was proposed with 4-lanes in their FS study. Accordingly, in 2030, the numbers of lanes for Dhaka-Chittagong corridor is expected to become 12-lanes in Kanchpur and 10-lanes in Meghna/Gumti.

Table 2. Proposed lane numbers for 2nd bridges

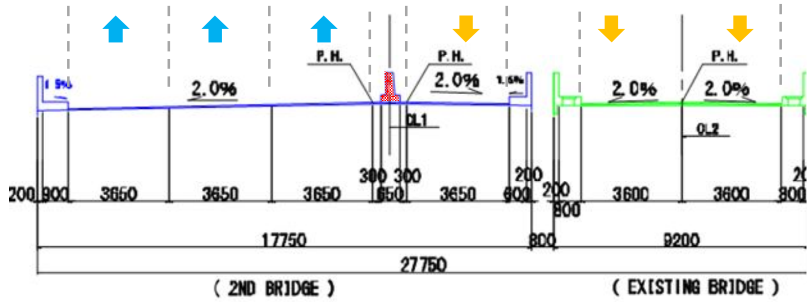
Survey location	Year 2012		Year 2021		Year 2030		No. of lanes		
	pcu/ day	Required lane no.	pcu/ day	Required lane no.	pcu/ day	Required lane no.	Adopted	Existing bridge	2nd bridge
Kanchpur Bridge	76,732	6	123,301	8	192,687	12	8	4	4
Meghna/Gumti Bridges	65,008	4	105,374	6	165,168	10	6	2	

2.3 *Lane Dividation*

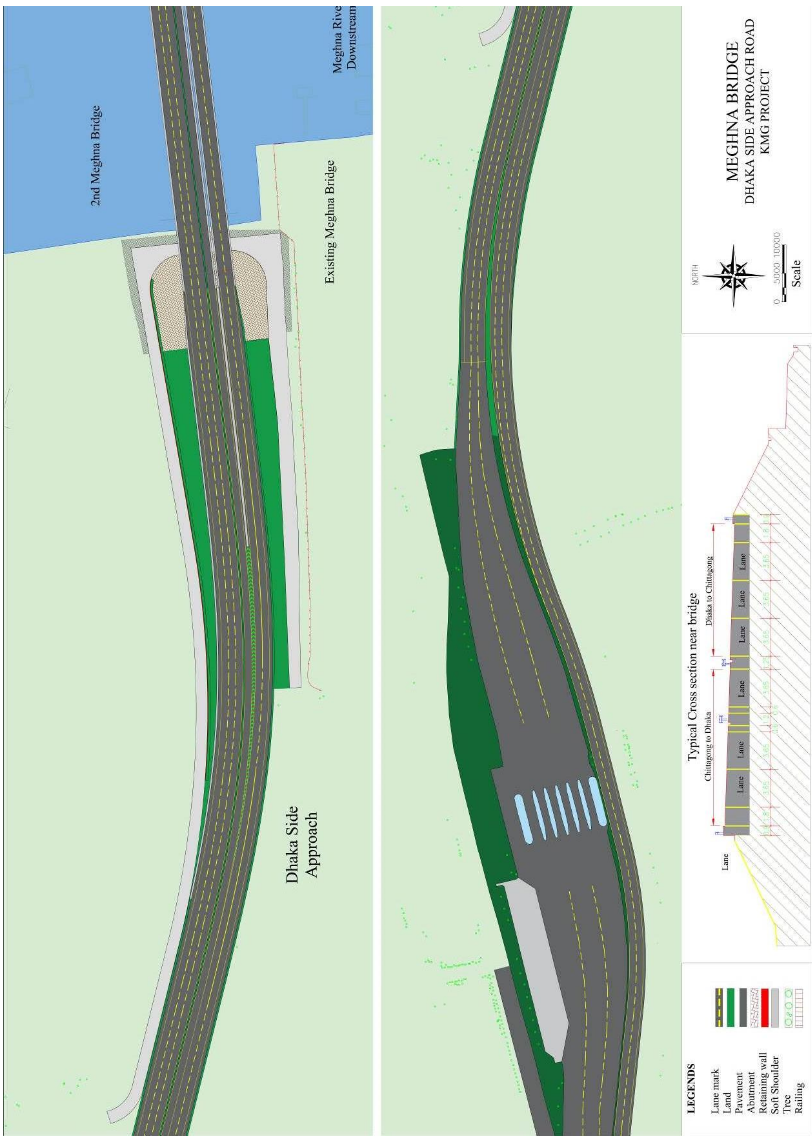
Three 4-lane 2nd bridges are planned to construct next and parallel to the existing bridges and their deck level is designed to keep at the same level and 800 mm offset side by side. The exiting Kanchpur Bridge is 4-lane whereas the existing Meghna and Gumti Bridges are 2-lane. In order to ensure smooth traffic flow and safety, 4-lane existing Kanchpur Bridge will be operated for Chittagong bound traffic, whilst 4-lane 2nd Kanchpur Bridge will be under Dhaka bound traffic.

On the other hand, 4-lane of 2nd Meghna Bridge shall be divided into 3+1 lane, among which 3-lane shall be operated for Chittagong bound traffic and remaining 1-lane together with 2-lane of existing bridge shall be under Dhaka bound traffic. A traffic flow through a cross section at Meghna Bridge is schematically shown in Fig. 2(a). Typical plan view covering the bridge section and the approach section up to the toll booth is also shown in Fig. 2(b). At the approach section preceding the bridge, 3-lane (1-lane from 2nd bridge +2-lane from existing bridge) will be gradually reduced into 2-lane by placing a barrier. Ultimately, these 3-lane from bridge section will merge into 2-lane which is passing beside the toll booth.

Oppositely to Meghna, 4-lane of 2nd Gumti Bridge shall be divided into 1+3 lane, among which only 1-lane out of 4-lane together with 2-lane of existing bridge shall be under Chittagong bound traffic, and remaining 3-lane of 2nd bridge shall be allocated for Dhaka bound traffic.



(a) Lane dividation: Cross sectional view



(b) Lane dividation: Plan view

Figure 2. Lane dividation concept (Meghna Bridge

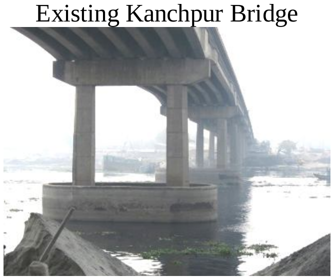
3 EXISTING BRIDGE TYPE, CONFIGURATION AND DAMAGE CONDITION

3.1 *Geometric Configuration*

The existing Kanchpur is 8-span bridge with a total of 396.5m in length having a maximum span of 73.2m. The superstructure is PC-I girder type connected transversely by I-shape cross beams. The existing Meghna is 13-span bridge with a total length of 930m having 87m maximum span. Its 11 spans from Dhaka side are PC box type having hinge and expansion joint at mid span. The end 2 spans at Chittagong side are PC-T girder type.

Likely to Meghna, the existing Gumti is 17-span bridge with a total length of 1,410 m and its superstructure is continuous PC box girder type having hinge and expansion joint at mid span. The detailed geometric configurations are briefly summarized in Table-3.

Table 3. Geometric configuration of existing bridges

Existing Kanchpur Bridge 	Construction	September 1973 to September 1977
	Bridge length (m)	$(\underbrace{4\times 42.7}_{\text{Simple}}+\underbrace{(54.9+73.2+54.9)}_{\text{Continuous}}+\underbrace{42.7}_{\text{Simple}})=396.5$
	Bridge width (m)	12.81 (road) + 2×0.686 (sidewalk) + 2×0.229 (railing)=14.64
	Superstructure	Pre-stressed concrete I girder, simply supported type
	Substructure	Abutment: Inverted T-type /Pier: Rigid frame-type
	Foundation	Abutment: Spread foundation / Pier: RC open caisson
Existing Meghna Bridge 	Construction	March 1987 to February 1991
	Bridge length (m)	$\underbrace{(48.5+9\times 87.0+48.5)}_{\text{Continuous PC box}}+\underbrace{2\times 25.0}_{\text{Simply supported PC-T}}=930.0$
	Bridge width (m)	7.2(road) + 2×1.0 (Sidewalk +Railing) =9.2
	Superstructure	Continuous PC box girder with rigid frame type with center hinge / PC-T girder with simply supported type
	Substructure	Abutment: Inverted T-type / Pier: Columnar type
	Foundation	Abutment: RC pile (φ1500) / Pier: RC pile (φ1500)
Existing Gumti Bridge 	Construction	March 1992 to November 1994
	Bridge length (m)	52.5 + 15x87.0 + 52.5 = 1,410
	Bridge width (m)	7.2 m (road) + 2×1.0 m (Sidewalk +Railing) =9.2
	Superstructure	Continuous PC box girder with rigid frame type with center hinge
	Substructure	Abutment: Inverted T-type / Pier: Columnar type
	Foundation	Abutment: RC pile (φ1500) / Pier: RC pile (φ1500)

3.2 *Damage Condition*

The deteriorations of existing Kanchpur, Meghna and Gumti Bridges were only a result of normal aging except those of the expansion joints in all the bridges and the hinges in Meghna and Gumti Bridges. In addition to the deterioration due to normal aging, heavily overloaded trucks and huge volume of traffic have made the hinges and expansion joints in the multi-span pre-stressed concrete of Meghna and Gumti Bridges to lose the proper functioning. It has been observed that the hinges lost their proper function to transmit the shearing forces between the cantilevers projecting from the piers, generating noises and unfavorable impact forces on the expansion joints when vehicles move from one cantilever to the other cantilever. As summarized in Table 4, the deterioration observed on the three bridges during the JICA FS, such as cracks, rebar exposure and damage to hinges, bearings and expansion joints, has been attributed to the normal aging process, overloaded trucks and insufficient maintenance.

The riverbed measured along the center line of existing Meghna Bridge showed the tremendous extent of riverbed scour leaving the bridge piers in a critical condition. The deepest riverbed -6.80 m.PWD (in 1991), -21.95 m.PWD (in 1997), -21.754 m.PWD (in 2005), -19.26 m.PWD (in 2010), -21.55 m.PWD (2012) was measured in the bathymetric survey in Meghna River. Therefore, the Meghna riverbed scouring is becoming critical issue day by day and undoubtedly necessitates an appropriate countermeasure for bridge construction.

Table 4. Deterioration of existing bridges

Cracks	Water leakage	Rebar exposure	Damaged expansion joint	Damaged bearing of hinge	Rubber plate at hinge bearing
					

3.3 *Emergency repair of Meghna and Gumti Bridges*

Emergency repairs and countermeasures have been undertaken for the Meghna and Gumti bridges in 2012 and 2013 to curb deterioration and protect the bridges until the full rehabilitation of the existing bridges and construction of 2nd bridges are completed. In July 2012, the Government of Bangladesh installed a durable, locally available steel plate on the damaged expansion joints and hinge bearings to restrain their vertical movement. From July 2012 to March 2013, all rubber expansion joints were replaced by finger type joints and the damaged hinge bearings were replaced. Scour protection works on the riverbed were undertaken on Meghna Bridge by placing geotextile-bags filled with sand and Cement Concrete (CC) blocks.

Table 5. Some of the emergency rehabilitation works carried out by GOB

	
Installation of sand bags in Meghna	Rubber joint replaced by finger joint at Meghna Bridge

4 CONCEPT OF 2ND BRIDGES DESIGN

4.1 *Span Arrangement and Type of Superstructure*

The 2nd Kanchpur is a 6-span continuous bridge with total of 397.3m in length having 97.6m maximum span. On the other hand, the 2nd Meghna is a 12-span continuous bridge with total 930m in length having 87m maximum span. The 2nd Gumti Bridge is separated into two segments i.e., 9-span continuous and 8-span continuous. It has 17 spans with total 1,410m in length having 87m maximum span. The superstructure of 2nd bridge is continuous narrow box steel girder type which is monolithic with Steel Concrete Composite (SCC) slab. The steel girder is composed of three narrow box girders connected transversely by I-shaped cross beams. Each girder is supported by an elastomeric bearing at the box center.

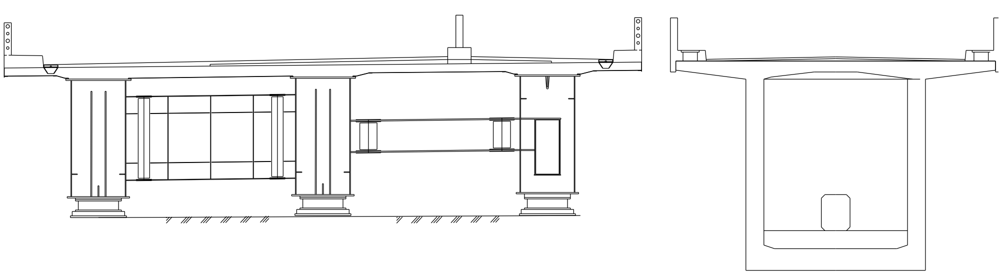


Figure 3.Cross section: Meghna Bridge

Expansion joints are provided at the location of both ends for Kanchpur, Meghna and Gumti Bridges, whereas additional expansion joint is provided at P9 (Fig. 4) for Gumti Bridge. The inclusion of additional joint dominates thermal stress rather than earthquake pressure.

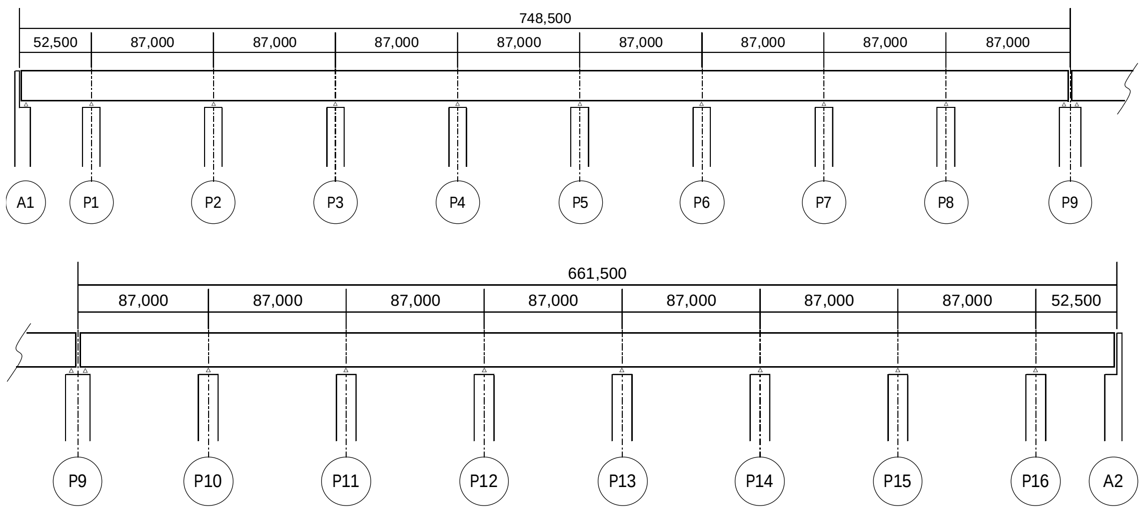
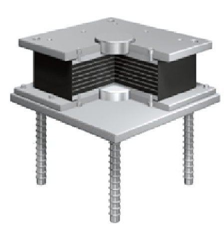


Figure 4. Expansion joint application at three locations (A1, A2 and P9) of Gumti Bridge

4.2 *Application of High Durability Rubber Bearing*

The narrow box steel girders are supported by elastomeric bearings at abutments and intermediate piers. The bridge superstructure is consisted of three narrow box girders which are laterally connected by cross beam. Each box girder is supported at the box center by rubber bearing which is integrated with stoppers so as to restrain lateral movements at the abutments. High Dumping Rubber (HDR) elastomeric bearing with adequate thickness is designed so as to absorb seismic energy by the damping effect and to reduce the movements and the uneven reaction forces.



Sketch of High Damping Rubber (HDR) Bearing

4.3 *Design Scouring Level for Foundation Design*

According to the bathymetric surveys conducted (DD Report, 2014) and considering previous results, the current riverbed conditions are studied and confirmed its changes from the past. Based on the study of river hydraulics, the water level, design discharge and design scouring depth (Table 6) are determined for respective pier foundation. These are used as input parameter for foundation analysis. Moreover, the necessity of river training works is appraised for Meghna River only. The riverbed near bridge Piers 3-10 is being planned to protect by installation Geo-bags, whereas the abutment A2 will be protected by revetment works including CC block, riprap and Geo-bags filled with sand.

4.4 *Seismic Analysis and Design*

The nonlinear seismic analysis of the 2nd bridges and the retrofitting of the existing bridges are conducted in accordance with the Response Spectrum (RS) proposed by BNBC (2006). The RS corresponding to S3 is used to predict the earthquake level which is expressed by design coefficient C_{sm} =1.2ZS/$T^{2/3} \leq$ 2.5Z, in which site coefficient S=S3=1.5 and Zone coefficient Z=0.15 are used. As the 2nd bridge is aligned parallel and next to the existing bridge and their foundations are planned to design as integral to the respective foundation of existing bridge, therefore, an integrated model is developed to carry out the seismic analysis. The design earthquake waveform an input parameter is applied at the pier base.

Table 6. River Hydrology

Items \ Bridge	Kanchpur	Meghna	Gumti
Standard High Water Level (m.MSL)	5.46	5.37	5.57
Design Discharge (100-yr), m3/s	3,480	21,910	12,400
Scour Depth (m. MSL)	Pier 2-3=-1.5 Pier 4=-11.0 Pier 5-6=-17.0	Pier 2=-5.0 ; Pier 3-5=-15.0 Pier 6-9=-24.0 ; Pier 10=-15.0	Pier 1=-1.0 ; Pier 2-7=-18.0 Pier 8-12=-1.0 ; Pier 13-16=-3.0
River Training	Not Recom-mended	-Riverbed protection around Piers 3-10 by Geo-bag -Revetment work at A2 (CC block, Riprap, Geo-bag)	Not Recommended

4.5 *Type of Foundation*

Two types such as Steel Pipe Sheet Pile (SPSP) and cast-in-situ RC pile foundation are taken into consideration for the selection of foundation type. The design scouring level, earthquake force and form of existing foundations are the key factors for the selection of foundation type for 2nd bridge. For instance, due to the consideration of scouring countermeasure around the Meghna Bridge piers and the improvement of seismic capacity of existing bridges, the foundation of M-P8 (Fig. 5) is designed with Steel Pipe Sheet Pile (SPSP) closed to well shape and that is planned to be unified with that of existing bridge. Their construction sequence is also numerically ordered in Fig. 5.

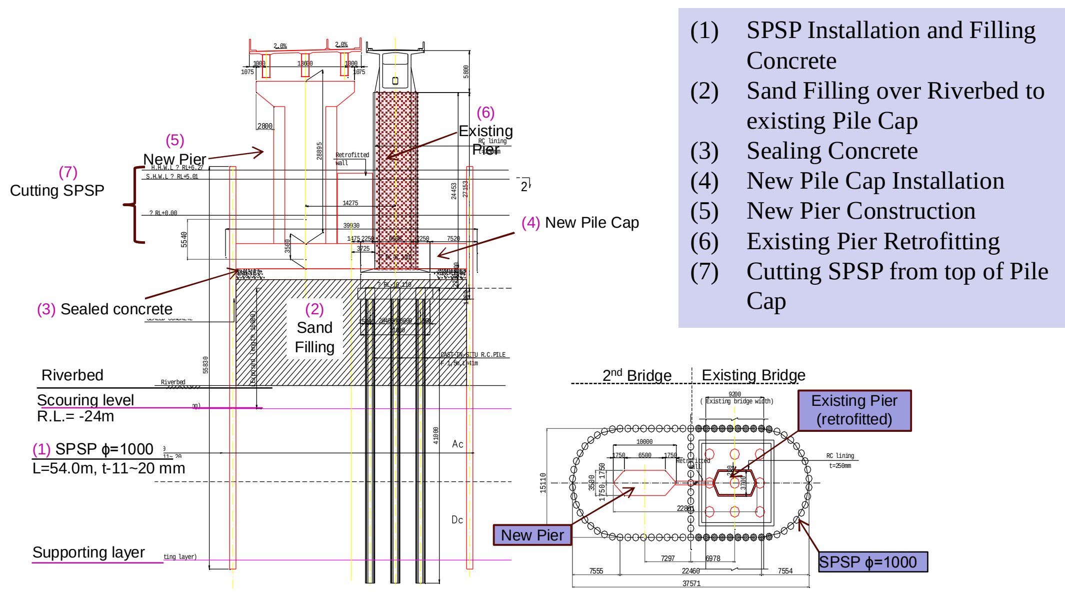


Figure 5. Integral of M-P8 foundation (Meghna Bridge)

4.6 *Summary of Technical Details Determined for 2nd Bridge Design*

Addressing to the set of design criteria (DD Report, 2014) and following AASHTO LRFD (2007, 2011) and Japanese design standard (JRA, 2012), the detailed design has been carried out for the proposed three 2nd bridges. The 2nd bridges are designed with a provision of 4-lane in width, keeping alignment next and parallel to the existing bridge. A summary of the technical details of the 2nd bridges is provided in Table 7.

Table 7. Technical details of 2nd bridge

Bridge name		Kanchpur	Meghna	Gumti
Bridge perspective view				
Length(m)		397.3	930.0	1410.0
Width(m)		18.0	17.45	17.45
No. of Lanes		4	4	4
Superstructure		Continuous narrow box steel girder with Steel Concrete Composite (SCC) slab		
Substruc-ture	Abutment	Inverted –T type		
	(No.)	2	2	2
	Pier	Wall type		
	(No.)	5	11	16
Foundation	Type (No.)	Cast-in-place RC bored piles		
		3 (A1, A2, P7)	4 (A1,A2, P1, P11)	12 (A1, A2, P1, P8-P16)
		Steel Pipe Sheet Pile (SPSP)		
		4 (P1,P3,P5,P6)	9 (P2-P10)	6 (P2-P7)

5 REHABILITATION OF EXISTING BRIDGES

The existing bridges were designed in accordance with seismic coefficient of 0.05. The revision of BNBC (2006) code substantially increased the coefficient to 0.15. This results in horizontal force to be in the range of 0.08-0.33, 1.6 to 6.6 times greater than the original design. Moreover, the present day live loading has substantially been increased from the original design live loading. As such this bridge had been designed with HS20-44, but presently loading is HL-93 type. In addition, severe scouring effect all-round the pier has been observed endangering the stability of pier in high flood condition. Therefore, consideration of above design factors effectuate on the necessity of rehabilitation and retrofitting of existing bridges.

5.1 *Superstructure Rehabilitation Plan*

(a) Existing Kanchpur Bridge

The rehabilitation works include replacing all damaged expansion joints and strengthening the deck slab. The deck slab needs to strengthen in order to sustain against the vehicle overloading. The deck strengthening is planned to execute by adhering two layers Carbon Fiber Reinforced Polymer (CFRP) sheet in the deck tension zone and primer coating application as a surface treatment.

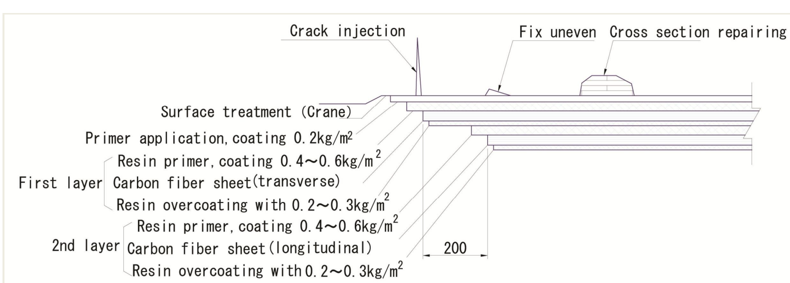


Figure 6. CFRP sheet application for deck strengthening

(b) Existing Meghna and Gumti Bridges

The rehabilitation works include replacing the damaged expansion joints in Meghna and Gumti Bridges, and fixing of all damaged hinges except that at the center of P5-P6 span in Meghna Bridge and that at the center of P4-P5 and P8-P9 span in Gumti Bridge. These three hinges (pot bearings) will be replaced by new with complete set. However, the process of fixing the center hinge will follow the subsequent sequences listed below:

i. Removal of expansion joint

ii. Casting concrete and having confirmed hardened concrete strength, PC bar will be connected
iii. Stressing the external PC cable and adhere carbon sheet on bottom slab.

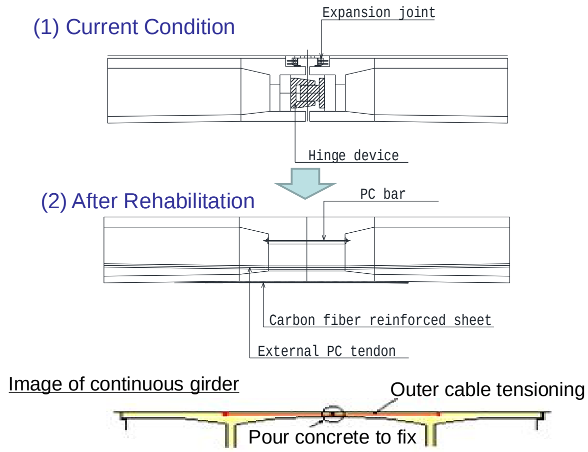


Figure 7. Existing damaged hinge to be fixed and repaired (Meghna and Gumti)

5.2 *Substructure and Foundation Retrofitting*

The strength of substructure of existing bridge has been confirmed with the current seismic loading. The seismic analysis reveals that the existing piers do not meet the requirements of resistance capacity; therefore, those piers have been planned to strengthen by RC-Lining. As is explained in Subsection 4.5, additionally SPSP foundation has been done to strengthen the existing foundations wherever appraised as necessary.

5.3 *Summary of Rehabilitation Plan for Existing Bridges*

Having examined the bridge condition survey results (FS report, 2013) and based on restoration analysis results (DD Report, 2014), a detailed rehabilitation plan is finalized for existing bridges. The summary of rehabilitation plan including items and methods for three existing bridges is enlisted in Table 8.

Table 8. Summary of rehabilitation items and retrofitting methods

Rehabilitation/Retrofitting works		Existing Bridge name		
		Kanchpur	Meghna	Gumti
Repair of cracks/rebar exposures		o	o	o
Connecting girders		-	o	o
Center hinge rehabilitation		-	o	o
Expansion joint replacement		o	o	o
Steel brackets on the substructures		o	o	o
Fail-safe connection with anti-seismic cable ties		o	-	-
Deck strengthening by CFRP sheet		o	-	-
Approach slab Replacement/Repair		o	o	o
Railing Repair/Cleaning of Bearing/ Repair of damaged pedestal		o	o	o
Pier foundation	RC-Lining	o	o	o
	RC Bracing wall	o	-	-
	SPSP foundation	P1 to P6	P2 to P10	P2 to P7

6 DISCUSSIONS AND CONCLUDING REMARKS

Currently GOB is implementing the widening of Dhaka-Chittagong National Highway N1 into 4-lane so as to cope with higher traffic demand. But, the existence of three major structures on N1, namely Kanchpur, Meghna and Gumti Bridges are causing bottlenecks against the widening of N1 due to their inadequacy in lane numbers. However, with the financial assistance from JICA, GOB is now implementing the KMG Project including the construction of three 2nd bridges and the rehabilitation of three existing bridges. The proposed 2nd bridges are designed with a provision of 4-lanes and aligned next and parallel to the existing one. The superstructure is continuous narrow box steel girder type monolithic with Steel Concrete Composite (SCC) deck slab and the foundation is designed with Steel Pipe Sheet Pile (SPSP) closed to well shape.

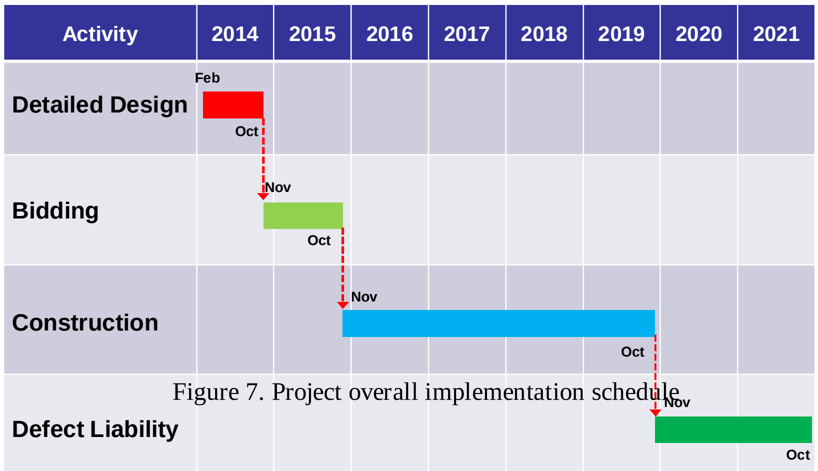


Figure 7. Project overall implementation schedule

Figure 8: Overall implementation schedule of the Project

A milestone for the implementation of KMG Project has already been prepared in order to monitor and appraise the overall construction progress. The total estimated construction period for the civil works including three 2nd bridges construction and existing bridges rehabilitation is 48 months (i.e. likely from Nov. 2015 to Oct. 2019, subject to the commencement of civil works). In particular, the construction period of 2nd bridges with approach roads is 36 months for Kanchpur Bridge, 42 months for Meghna and Gumti Bridges, and the completion of rehabilitation works for the three existing bridges is 48 months from the beginning. Defects Liability Period (DLP) is 24 months after completion of the whole civil works.

As is explained earlier, the KMG Project provides proper infrastructure development that will be capable to accommodate huge number of cargo movement. A comprehensive economic analysis was conducted to appraise the economic viability of the Project (FS Report, 2013). It reveals that the economic viability is secured at a higher feasibility level (Economic Internal Rate of Return, EIRR=24.9% for all bridges). Therefore, upon successful completion of the Project, the transport costs from Dhaka to Chittagong will greatly be reduced due to reduction of the traffic congestion. These phenomena will provide a favorable influence to the industrial section and export products in Dhaka Metropolitan Area, which will be an engine for the economic development and also subsequently promote the poverty reduction in Bangladesh.

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