

Work methodology for replacement of expansion joints of Meghna bridge in 2008

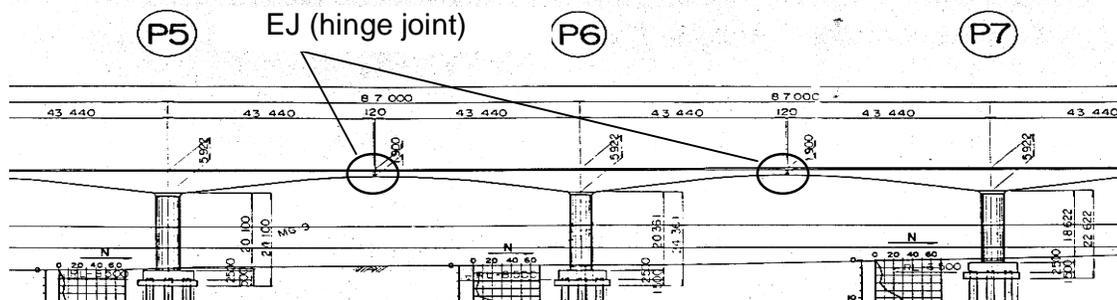
M. Sanaul Haque, Md. Abdus Sabur & Mofazzal Haider
Roads and Highway Department, Dhaka, Bangladesh

ABSTRACT: The road network of Bangladesh has a significant role in its economic development. It supports economic activity and freight transport. Dhaka-Chittagong corridor links Dhaka to the biggest port city Chittagong. Around 30% of total road freight is catered by this corridor. There are two long bridges on this corridor. The bridges are Meghna and Meghna-Gumti Bridge which were open for traffic in 1990 and in 1995 respectively. Excess loaded traffic over these bridges makes their expansion and hinge joints weak and put them in damaged condition. In May 2008 and in November 2008 the expansion joints of Meghna-Gumti and Meghna Bridges were replaced. In this paper how the replacement of expansion joints of Meghna Bridge was done, how the existing traffic over this bridge was managed and diverted and how the entire operation was done within the short time frame are presented. It is believed that the lessons learnt as documented in this paper will be helpful for the future decision makers for executing the same nature of job.

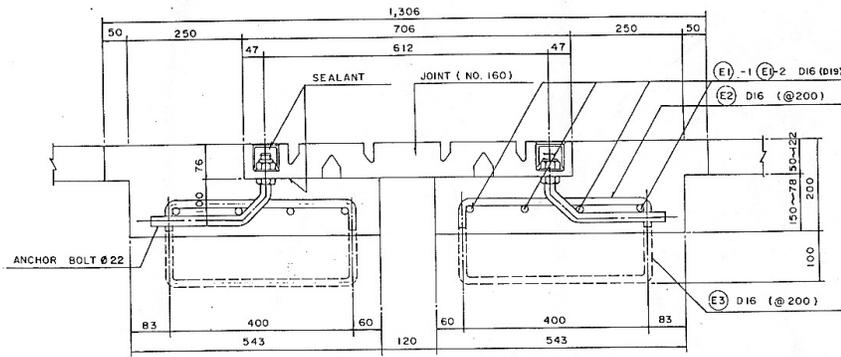
1 INTRODUCTION

Meghna Bridge is situated 28 km south east of Dhaka over the river Meghna which is a major river of Bangladesh. The bridge is located on Dhaka-Chittagong Highway. The bridge was opened for traffic in June 1990. There is another long span bridge Meghna-Gumti on this Highway and it was open for traffic in 1995. Overloaded traffic over these bridges makes their expansion and central hinge joints weak and damaged. In May 2008 and in November 2008 the expansion joints of Meghna-Gumti and Meghna Bridges were replaced. Methodology of replacement of expansion joints and repairing of central hinge bearing of Meghna Bridge is presented here.

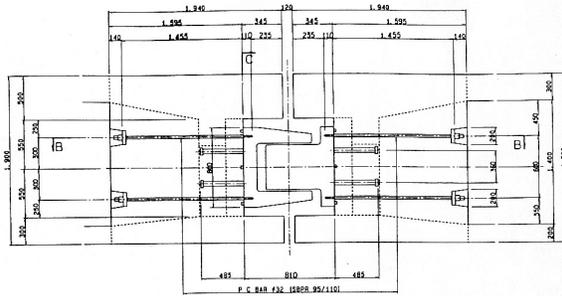
Meghna Bridge is a balanced cantilever and PC box girder bridge. It is 930 meters long and 9.2 meters wide. The bridge has thirteen spans and thirteen expansion joints. It has nine spans of 87 meters, two spans of 48.5 meters and two spans of 25 meters. The span order from Dhaka end are 48.5 m + 9x87.0 m + 48.5 m + 2x25.0 m = 930.0 m. The carriage way of the bridge is 7.2 meters. The foundations are supported on piled foundation. The piers of the bridge are hexagonal in shape. Each pier is of 11 meters in length and 3.2 meters in width. In November, 2008, the Meghna Bridge underwent extensive repair and replacement of expansion joints because the expansion joints of the bridge were damaged. Drawings of Meghna Bridge and related expansion joints are shown in Figures 1 and 2.



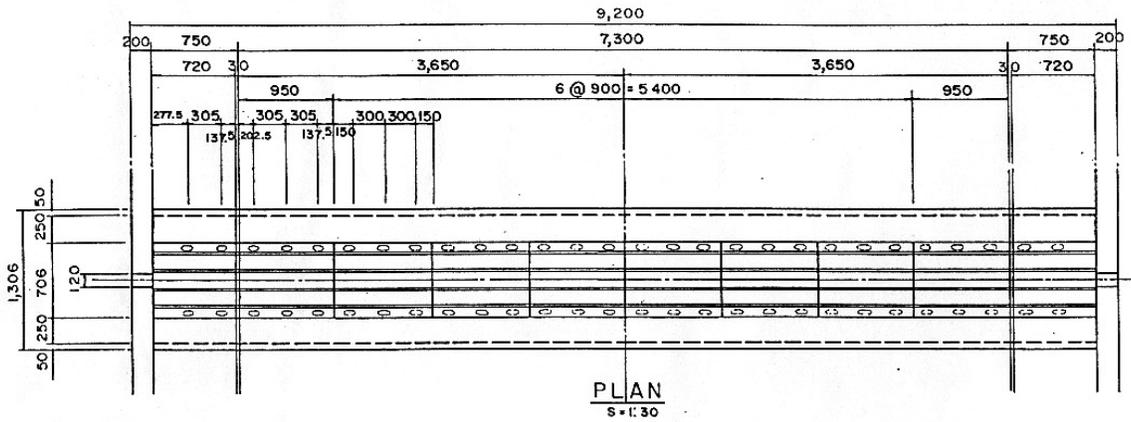
Figures 1. Elevation of the bridge



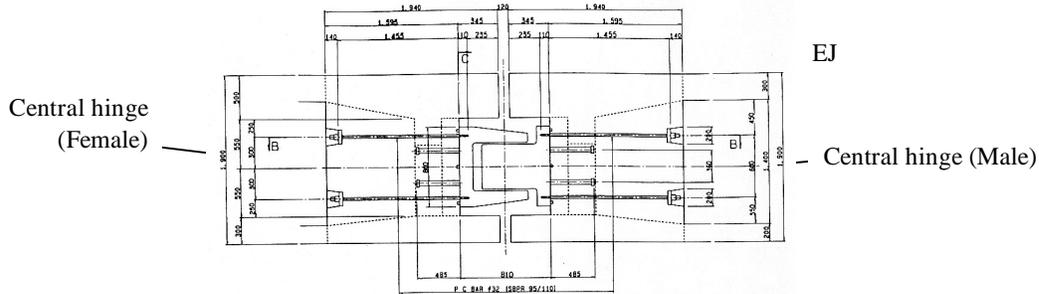
Location of EJ



Structure of original EJ (used for hinge joint position)



Arrangement of EJ segments



Position of EJ and central hinge in cross section

Figure 2. Drawings of Meghna Bridge and related expansion joints

2 PLANNING PROCESS

As it is an important bridge on National Highway and a key point installation of Bangladesh, the replacement of Expansion Joints might hamper normal traffic flow to the port city Chittagong. For that reason, the decision was made that public announcement would be circulated through electronic and printing media and then the repair work would be started keeping one lane of bridge open so bus, single axle truck and light weight truck could move over it. The steps of Expansion Joints (EJ) replacement are showing in Figure 3.

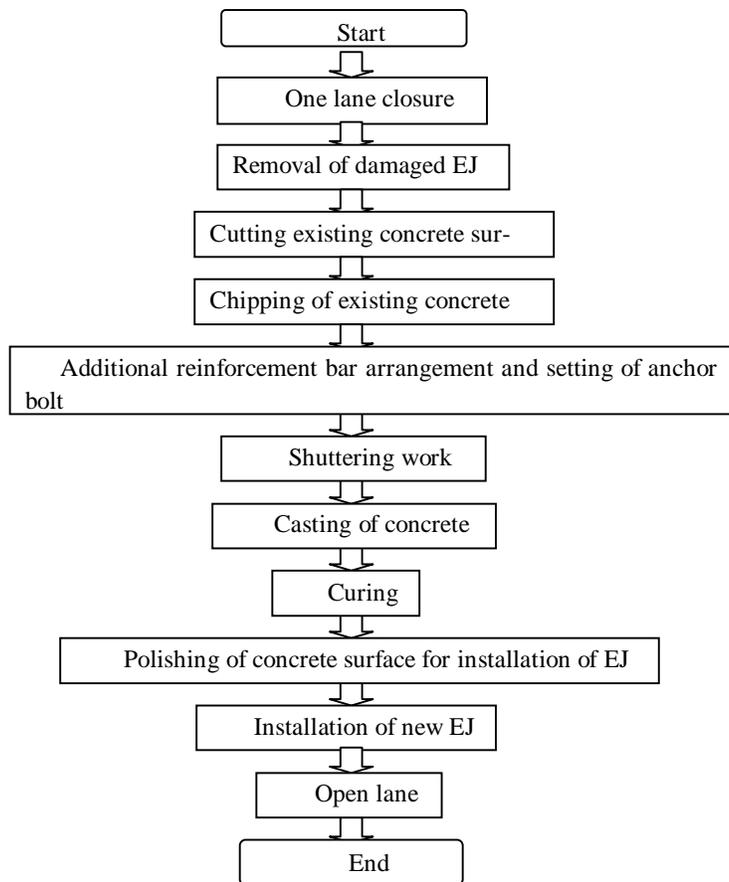


Figure 3. The steps of Expansion Joints replacement are shown

3 TRAFFIC DIVERSION AND LANE CLOSURE

After a secretarial meeting, co-ordination and communication have been established between Local Administration, Transport Owners, Security Forces and all others stake holders those who were involved with this work. Second important work was traffic diversion. Vehicles like Covered Van, Long Tailor and small vehicles like car, microbus etc were diverted through Dhaka-Sylhet Highway. Diversion of traffic had been done from Kan-chpur Bridge with the help of Highway and local police administration. The replacement work of expansion joints were done lane by lane basis. When one lane was open for traffic and the other lane was closed for work. Lane was divided in two parts and closed by metal drums, concrete blocks and ropes. It was maintained by the help of Highway Police, Local Police, Contractors Security Personnel and RHD staffs. Telephonic and mobile contacts were maintained all time between police and security personel of both sides. In every 30 minutes, traffic from Dhaka and Comilla side was open and closed simultaneously. Photographs of lane closure are shown in Figure 4.



Figure 4. Photographs of lane closure

Two ferries along with the jetties were ready for emergency. The approach road of ferry and jetties were made usable in a short period of time. Some emergency patients and passengers were passed by ferry, when the bridge was closed for 18 hours for two times. Toll plazas were also used for controlling traffic movement from both sides.

4 CUTTING OF CONCRETE SURFACE AND REMOVAL OF DAMAGED EXPANSION JOINTS

Concrete surface was cut and damaged expansion joints were removed. At first the measurements for cutting and breaking of concrete were made. Concrete was cut by a mechanical cutter and damaged expansion joints were removed by breaking of concrete by the help of chisel and hammer. It required 30 minutes for concrete cutting and approximately 6 hours for breaking of concrete at each expansion joint. Six groups of worker were engaged for mechanical cutting and manual breaking of concrete. Within two days time, breaking of all the 13 joints were completed (half width). Photographs of concrete cutter, concrete cutting and chipping are shown in Figure 5.



a) Concrete Cutter



b) After cutting



c) Chipping of concrete



d) after chipping

Figure 5. Photographs of concrete cutter, concrete cutting and chipping

When the chipping of concrete was completed, the areas of expansion joints were cleaned. Corrosion and dent at corners of reinforcing bars were observed. After removing of expansion joints damage of its material and fracture of concrete at the edge of deck slab was found. The fractures of concrete have made the gap of expansion joints wider and compelled the expansion joints to drop/sunk. Lengthwise and crosswise additional reinforcement bars were added in the bed of expansion joints to avoid reoccurrence of cracks at the edges of deck slab. Different angle bar templates were made to place different sizes of expansion joints and anchor bolts in accurate positions.

Measurements were made carefully, so that expansion joints could be placed safely and accurately. Measurements were calculated keeping temperature factor in mind. All the additional reinforcements, placing of templates & shuttering form work and fixing of bolts were done by welding. All necessary welding of reinforcement and placing of bolts were completed within three days. Cutting & chipping of concrete and placing of additional reinforcement were done simultaneously by six group of worker. This part of job was done within four day time. After placement of additional reinforcement shuttering work were done by the help of wood and polythene. Polystyrene foam wrapped with polythene sheet was used in the gap of expansion joints. After the shuttering work, casting area was covered with polythene sheets to keep it clean. Photographs of expansion joint placement are shown in Figure 6.



a) Welding



b) Additional bar reinforcement



c) Setting of anchor bolts/templates



d) Shuttering work

Figure 6. Photographs of expansion joint placement

5 CONCRETING

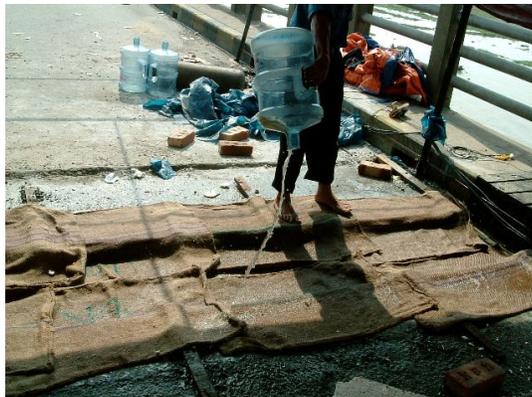
When the beds of expansion joints were ready for casting, the bridge was closed for 18 hours. This sort of total closures of bridge was done for two times. The information of bridge closures was announced through electronic and printing media three days prior to concrete casting. Concrete casting was done on 11.11.2008 at left lane of Dhaka end. It was done by the help of concrete mixer. Compaction and surface finishing were done by vibrator and by hand trowel. Usually concrete casting was done from 7.00 pm to 2.30 am at night without any

break.

To reduce initial and final setting time of cement and to acquire sufficient permissible strength of concrete for vehicles passing, admixture (Super Plasticizer Scancem SP1B-1.5% of cement) was used. The mix ratio of Cement: Sand: Stone Aggregates (12mm downgraded) was 1: 1.20: 2.40 and water cement ratio was 35%. After completion of concrete casting, curing was done all day long and continues for three days. Concrete surface level was adjusted to road surface level by grinding and strength of concrete was measured by Schmidt hammer. The concrete strength was greater than 2000 psi after 12 hours. The strength of concrete was good enough to withstand vibration. At 12.00 am on the next day, the lane of bridge was open for traffic where concrete was not cast. After 48 and 72 hours the concrete strength at surface level was 4000 to 4200 psi and 4500 to 5000 psi respectively. Photographs of concrete casting, curing and strength tests are shown in Figure 7.



a) Concrete casting



b) Curing



c) Strength test

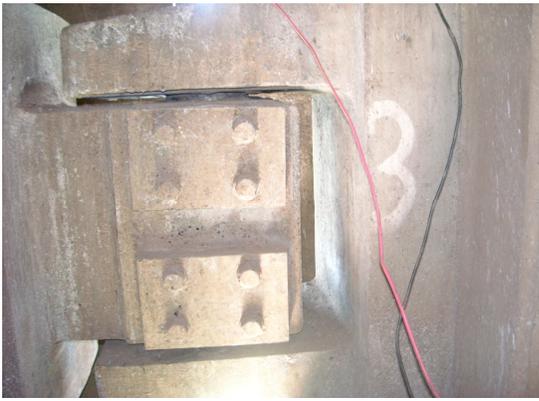
Figure 7. Photographs of concrete casting, curing and strength tests

6 REPAIRING OF CENTRAL HINGE

During the replacement of expansion joints additional steel plates were inserted between the gaps of damaged male and female central hinges to minimize excess movement of expansion joints. However, it is still uncertain at what interval the replacement of central hinge bearings is to be done. Photographs of central hinge and damaged hinge bearings are shown in Figure 8.

7 INSTALLATION OF EXPANSION RUBBER

Installation of expansion rubber was started after initial setting and adjusting of concrete surface level. After placing of expansion rubber, specific sizes of bolts were used to fix the specific sizes of expansion joints. When the fixing of bolts were completed, high resilient rubber type sealant was used to resist the movement of bolts and the rubber sealant was placed over the bolts as a cap. Photographs of installation of expansion rubber are shown in Figure 9.



Hinge



Damaged Hinge bearing

Figure 8. Photographs of central hinge and damaged hinge bearing



Installation of EJ & fixing of bolts



Placing of caps

Figure 9. Photographs of installation of expansion rubber

8 CONCLUSIONS

After 72 hours of concrete casting the left lane was opened for traffic at 12.00 am on 12.11.08 and at the same time the right lane was closed. All the steps done on left lane of Dhaka End were followed for the right lane. Again traffic was fully closed over the bridge on 20.11.08 for concrete casting on the right lane of Dhaka End. During the total closures of bridge, traffic was diverted or de routed through Dhaka-Sylhet highway. On 26.11.08, nine days before the deadline or expected finishing date of 5.12.08, the replacement of expansion joints was completed and the bridge was fully opened for traffic. Every day about 70 workers were engaged for 18 hours in replacement of expansion joints and 30 security personnel were engaged all the time on the spot to manage the traffic movement. It would not be possible to complete the replacement of expansion joints before the expected time or within the timeframe except the combined effort of local administration, police administration, transport owners, RHD Officials, Staffs & Contractor's of Narayanganj Comilla, Brahmanbaria, Narsinghdi and above all the patience of people from all over the country.