

RECORDS OF DISCUSSIONS  
AT  
TOKYO MEETING  
FOR  
JAMUNA BRIDGE PROJECT, BANGLADESH

SEPTEMBER 1974

JICA

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国際協力事業団	
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1. RECORDS OF DISCUSSIONS

(1) GENERAL

(a) Summary of progress of the study and its future schedule

Having the nomination by the Chairman of this meeting, Dr. Inose reported the summary of progress of this study and its future schedule.

The description was given briefly according to the contents of the General Progress Study Report for Jamuna River Bridge Construction Project (First Stage) which presented from the JICA (OTCA) to the Government of the People's Republic of Bangladesh prior to the Tokyo Meeting.

Contents of report are as follows:

- a. Outline of works carried out by the surveying team and future work schedule.
- b. Outline of works carried out by the Geological and Quarry Survey Team and future work schedule.
- c. Outline of works carried out by the River Planning Team and future work schedule.
- d. Outline of works carried out by the Economic and Traffic Study Team and future work schedule.
- e. Outline of works carried out by the Highway and Railway Planning Team and future work schedule.  
(Ferry study included)
- f. Outline of works carried out by the Bridge Planning Team and future work schedule.

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All items were understood by the Bangladesh Government Mission.

(b) Evaluation of the Proposed Sites.

Having the nomination by the Chairman of this meeting, Dr. Inose reported the evaluation of the four proposed sites on the basis of the results of studies upto now.

As described in the Inception Report which was presented by the OTCA to the Government of the People's Republic of Bangladesh, the evaluation was made taking the following criteria into consideration:

- a. Stability of the river channel.
- b. Expected traffic volume through the bridge when completed.
- c. Total cost of construction.

The results of the evaluation of priority were shown as the table attached herewith.

The evaluation is expressed in order of A, A', A'', B and C. A has top most evaluation.

As is shown in the attached table, we wish to recommend Sirajganj site as a most suitable bridge site from among the four proposed sites.

(c) Description of Agenda of the Meeting.

Having the nomination by the Chairman of this meeting, Dr. Inose explained the Agenda attached herewith which was presented by the JICA (OTCA) to the Government of the People's Republic of Bangladesh prior to the Tokyo Meeting.

The items are as follows:

- a. Effective width of the Bridge.
- b. Minimum width of the Jamuna River.
- c. Design discharge for bridge construction.
- d. Procurement of stones.
- e. Route location of railway links.
- f. Gauge length of the railway links.
- g. Route location of highway links.
- h. Navigation clearance for rivers other than the Jamuna.
- i. Information to be required for further development of the study on economy and traffic volume.

Fruitful discussions were made among the participants of the meeting about the above mentioned items.

Relating to the above items, some comments were presented by the Bangladesh Government Mission.

Details of the discussion have been incorporated in the records of the discussion of the part meetings and are attached herewith.



Evaluation of the Proposed Sites

Proposed Sites	Stability of River		Comparison of Construction Cost			Length of Highway Access and Railway Access		Traffic Volume	Evaluation of Priority
	Geomorphology	River-morphology	River Works & Bridge Works			Highway	Railway		
			2 km	River Width 4.2 km	5.2 km ~ 5.6 km			km	km
BAHADURABAD	B	B	A	A	A"	70	100	B	B
GABARGAON	A'	A	A'	A	A'	66	95	B	A'
SIRAJGANJ	A	A'	A'	A	A"	52	114	A	A
NAGARBARI	C	C	B	A'	A"	37	120	A	B

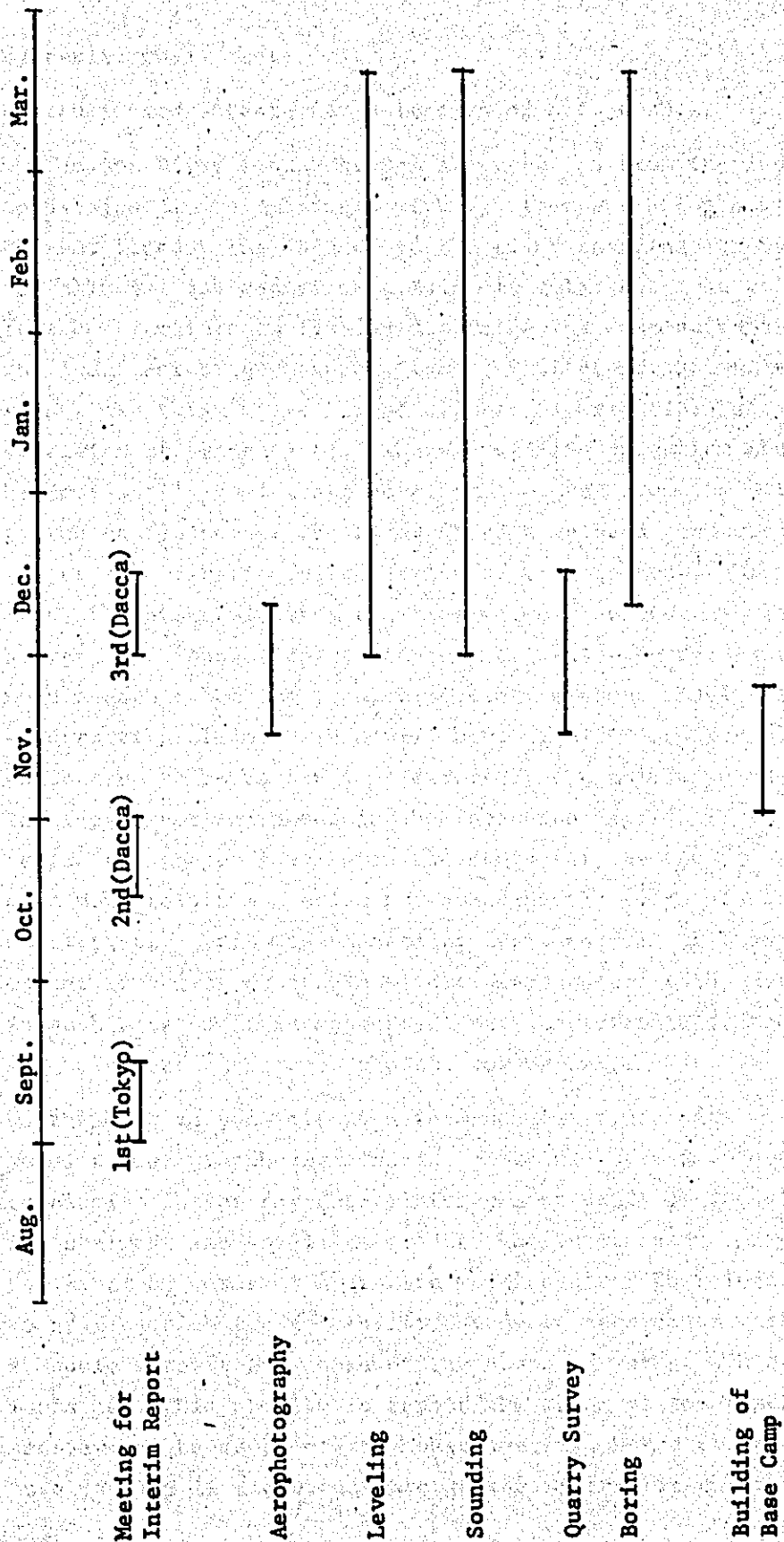


(d) Survey schedule in Bangladesh in the Japanese fiscal year 1974.

Having the nomination by the Chairman, Dr. Inose explained the survey programmes which are scheduled for the Japanese fiscal year 1974. The survey programmes are given in the bar chart attached herewith.

In order to complete the feasibility study within the three years mentioned in the Inception Report, the topographic surveying of the most suitable site and the borings along the bridge axis must be done during the coming dry season. To attain this purpose, the most suitable bridge site must be determined at latest by the beginning of November 1974. This was strongly insisted upon Dr. Inose.

SURVEY SCHEDULE IN BANGLADESH



(e) Hydraulic model tests.

a. Hydraulic model tests for selection of bridge site.

B: The Jamuna River flows through alluvial fan from the India border to Sirajganj. This being a mighty river and being subject to recurrent floods, the chances of the river changing its course in the alluvial fan cannot be completely ruled out. It will therefore be premature to finally determine the most suitable site on the judgement by geomorphological and river-morphological studies alone. We think hydraulic model test is essential before final selection of bridge site. Therefore, site selection should not be done until model tests covering the area from the northern border to the confluence of the Padma River have been conducted. Secondly, one of the criteria for selection of site is cost. Without a model test, the scale of river training works required, the length of the bridge, the foundation structure etc. cannot be forecast. Therefore no dependable costing is also possible without model test. Thirdly, construction of the bridge will have significant back-water effect which need to be carefully prestudied on a model. Although model-testing is not mentioned in the Inception Report, it is possible to revise the scope of works in the course of the study. We request to make more reliable studies by expanding the scope of works to include model tests. This was repeatedly insisted. It will be unavoidable matter if the study should be prolonged owing to the model-testing. In such a case, it is suggested that the revision of the scope of works may be discussed between the two governments.

J: We think it is possible to determine the bridge site without hydraulic model tests. Furthermore we do not think the model tests can be a conclusive factor for determining the priority of the sites because it is almost impossible to predict the future state of stability of the river by means of hydraulic model tests. Therefore, we would like to proceed with the feasibility study in accordance with the fixed schedule without any change of the scope of works. This was repeatedly insisted. This problem is beyond the range of the fixed scope of works and beyond the range of the Tokyo meeting, hence it is requested that this problem is discussed through the diplomatic channel.

b. Hydraulic model tests as to the most suitable bridge site.

B: Normally for construction of bridges, model study is not necessary. But in this case, because of the nature of the river, river training works constitute the most difficult problem. Therefore, no feasibility study will be worthwhile or dependable without a model test of the river.

J: We do not think it is necessary to conduct those model tests for making the feasibility study and suggest that, at the stage of detail design, some hydraulic model tests will be conducted in accordance with necessity.

(f) On the schedule of the study.

B: Why is it necessary to narrow down the bridge sites to one single site so hastily at the present stage?

J: It was repeatedly insisted that, in order to carry out the feasibility study in accordance with the fixed schedule of the scope of works, we must, at latest in the coming dry season, carry out the topographic surveying of the finally determined bridge site and the geological surveying by test borings along the finally determined bridge axis.

(g) On the test borings.

B: Only one test boring was carried out at each of the four proposed sites. We think these four borings alone are insufficient for the geomorphological study. Therefore we think it is necessary to add more borings in the longitudinal direction along the river course.

J: The objective of the four borings was to obtain the data required for the design of substructures of the bridge.

We think the geomorphological studies which have already been made are sufficient to give data to evaluate the priority of the bridge site.

(2) GEOLOGY AND QUARRY

(A) Study of Foundation Conditions at Bridge Sites

Discussion has been made on the comments related to the geological survey at the alternative bridge sites.

J: It was commented in the "General Comment" that the gravels in the deep layers are outcome of the glaciation process. The Team's study disclosed that the comment was right. It was testified by the radio-isotope dating made on the fossil wood obtained by the Team's drilling from the layer in the depth of 110 meters. By the dating, the layer is assessed as 28,000 years old or of last glacial age corresponding to the later period of Würm Epoch.

B: The Mission considers it as premature to assess the most viable site by drilling at only one point along each alternative site.

J: The scope of the geological survey at the first stage was limited to investigate general conditions at each alternative site extending over 150 kilometers and to make preliminary comparative study. The period of field survey (dry season) was limited, and effort has been made to complete four drillings to the depth of 400 feet. Therefore, the profile in the Progress Report indicated only the general tendencies of the layer distribution and not the definite geological profile.

B: The Ministry of Communications requested that drilling be made at a site inbetween the alternative bridge sites to assess the distribution in more detail and then to appraise the alternatives.

J: It was the Team's schedule to investigate the general ground conditions of longitudinal direction by four drilling during the first stage, to make comparative studies on the basis of various technical and economic factors including transportation economy, socio-economic conditions, etc., and to select a priority site in the first stage survey. During the second stage survey in the coming dry season, it is scheduled to make five drilling of 400 feet in depth at the site selected by the first stage investigation and studies.

But the Government of the People's Republic of Bangladesh requested the drilling should also be made at the intermediate point between Bahadurabad, Gabargaon and Sirajganj sites along both banks of the end-Jamuna and in the corresponding river beds to come to a definite conclusion.

(B) Procurement of Stones

J: Comments of the Bangladesh Mission have been presented in four papers as follows:

- 1) General Comments by Mr. G.Kibria & Jamuna River Advisory Committee
- ii) Comments from Chief Engineer, Railway Dept. to Secretary, Ministry of Communication, dated 17 August 1974, 1974
- iii) Comments from Geological Survey to Mr. L.Huq, dated 15 August 1974
- iv) Comments (II) from Chief Engineer, Railway Dept. to Ministry of Communication, dated 26 August 1974

Regarding the procurement of stones commented in the papers mentioned above, explanation is made, item by item, as follows:

1. No comment on the procurement of stones has been presented in the General Comments referred to i) above.
2. Re: Comments from the Railway Dept.:
  - 2-1) Chief Engineer's comments stated that it might be possible to make geological reconnaissance in the Assam State, India. It is quite desirable to make the survey, but it is the impression of the Survey Team that the survey in the Assam State is difficult to be allowed.
3. Re: Comments from Geological Survey:
  - 3-1) From the Bholaganj source, it is possible to pick up some stone materials for the bank protection works. However, it is not possible quantitatively to meet the huge requirement of stones of several million cubic meters.
  - 3-2) The Geological Survey Team visited the Dinajpur limestone project site pointed out in the papers. It was observed that extraction of stones from 500 meter underground would be possible, but procurement of 4,000 cubic meters of stones per day was judged as practically difficult. The unit procurement cost from the said underground mining would be several times as high as ordinary surface exploration. However, procurement of stones and boulders from Bangladesh source will be examined further when the survey team goes to Bangladesh during next dry season.

4. Re: Comments (II) from the Railway Dept. dated 26 August:

4-1) Stone materials deposited to the north of Jamalpur were surveyed by the Team. Quantitatively, the Jamalpur deposit was too small to meet the contemplated daily requirement of 4,000 cubic meters.

4-2) Use of artificial boulder and the concrete blocks were commented. The Team is of opinion that such measures will be an ultimate resolution when the natural deposits are found unobtainable. The study on these measures will be made in the final report.

B: Explanation by the Geological Survey Team on the procurement of stones has been understood. The Bangladesh Mission requests explanation on the longitudinal profile of the bridge sites worked out as the results of the four drilling survey.

J: The discussion on the bridge site profile is a subject related to the bridge foundation. It is preferable to discuss it under the subject of "Construction of Bridge" at another meeting.

B: The Mission is agreeable to the proposal to discuss the bridge site profile at the meeting on the "Construction of Bridge."

J: The stone procurement is of prime importance in bridge construction. The Team requests further comment by the Government of the People's Republic of Bangladesh on the import of stones from India in case indigenous materials are unavailable.

B: The Government of the People's Republic of Bangladesh is in the hope that studies on the availability and unit price of stones will be made on:

- i) domestic materials
- ii) imported materials
- iii) artificial materials

J: The Team wishes to hear about the particular point on the import of stones from India.

B: It was suggested that effort be made use of the indigenous materials as far as practicable. The Government's official comment will be forwarded after confirmation from the authorities concerned.



B: Rock materials in the West Bengal State, India is considered as a possible alternative. It is requested that the survey will be made at this site in the coming field investigation. The Ranipukur mine located in the north-northwest Bangladesh would be another possible site.

J: The Team has the same opinion that there is a possibility of exploration in the northwest region of Bangladesh. The Team has already programmed to make a survey in West Bengal during the coming dry season. No reconnaissance has been made at the Ranipukur site, but the survey made around Rangpur disclosed that the deposit was too small to meet the requirement. The Team will make a survey, for confirmation sake, at Ranipukur during the coming dry season.

(3) RIVER TRAINING WORKS

In the part meeting for river, discussions were made on the premise that Mr. Kibria's comments represent the Bangladesh side.

1. General.

B: Mr. Kibria's comments (his document: Volume 4, 1, page 2).

J: In accordance with the written agreement which was made at the time of submitting the Inception Report, important data will be given in F.P.S. system as well as in metric system.

B: Agreed.

2. Geomorphological land classification map of Bangladesh.

B: Mr. Kibria's comments (his document: Volume 4, 2, 1), page 2).

J: We are preparing a new geomorphological classification map of Bangladesh by Earth Resources Technology Satellite. In the new map, alluvial fan, natural levee, back-swamp and delta will be shown clearly.

B: Agreed.

3. On the division of the alluvial fan and natural levee at Sirajganj.

B: Mr. Kibria's comments (his document: Volume 4, 2, 11), page 2).

J: Agreed.

4. Ground subsidence of the Ganges Delta.

B: Mr. Kibria's comments (his document: Volume 4, 2, iii), page 3).

J: The north western part of the Ganges Plain has been upheaved and the south eastern part has been downwarped.

B: Agreed.

5. Eustatic movement in Bangladesh.

B: Mr. Kibria's comments (his document: Volume 4, 2, iv), page 3).

J: We presumed the eustatic movement in Bangladesh based on the studies in Japan as a sample in the orogenic zone and Korea in the epeirogenic zone. Bangladesh is located in the Alps-Himalaya Orogenic Zone.

When we consider the formation process of the plain, we must consider not only the eustatic movement but also ground movement. If we have a chance to study in the Ganges Delta on the problem in another project, the problems may be solved.

B: Agreed.

6. Fault line in the plain.

B: Mr. Kibria's comments (his document: Volume 4, 2, v), page 3).

J: We have data on fault line. The problems will be included in the Draft Interim Report.

B: Agreed.

7. Features of the morphology of the alluvial fan and its formation process.

B: Mr. Kibria's comments (his document: Volume 4, 2, vi), page 3).

J: Based on the geomorphological study, we presume the alluvial fans belong to young stage. We presume that the alluvial fans are not advanced to the lower reaches from Sirajganj so fast, partly because there are many back-swamp areas which will be buried in the near future, partly because there are small natural levees along the present river course which show the variation from alluvial fan to natural levee and partly because there is a narrow at Sirajganj which has continued for about 200 years.

8. Possibilities of shifting of the river course in the alluvial fan.

B: Mr. Kibria's comments (his document: Volume 4, 2, VII), page 4).

J: There are possibilities of diversion in the alluvial fan. In case of such an eventuality, the channel may be turned back by engineering measures to the present course at the upper part of the Town of Sirajganj or any other site upstream of Sirajganj. There may be possibilities of shifting from the present course to the Old Brahmaputra or any other fault line in the alluvial fan region in the future, because the shifting from the Old Brahmaputra to the present course has taken place not only by the variation of the silting but also by the upheaval ground movement of the eastern Barind Terrace. River training may be required to stabilize the Jamuna in case indication

of occurrence of any such avulsion should begin to appear in the stretch from the Garohills up to the proposed bridge site.

B: River training will be required to stabilize the Jamuna from the Garohills up to the proposed bridge site in order to prevent occurrence

B: of any such avulsion: mentioned above.

It may be decided by the two Governments as to whether cost of such stabilization will be charged to the bridge project or to any other project.

J: In case such problem should occur, it should be dealt with as an internal problem and should be solved by the Government of Bangladesh.

The influence of bridge to the surrounding rivers will be studied and will be taken into consideration in planning the bridge.

Any other problems concerning the whole river should be separated from this bridge project and should be treated as independent river training works or some other projects.

#### 9. Change of bank lines.

B: Mr. Kibria agreed.

#### 10. Bed materials.

B: Mr. Kibria agreed and he further presented another comment that there may be some difference between bed materials in the Jamuna River and in the Ganges River in view of braiding nature of the Jamuna River and meandering nature of the Ganges River.

J: That is a very interesting problem but the grain size of bed materials in the Ganges River does not have direct relations with the present project. Therefore, the survey of bed materials of the Ganges River has not been programmed in the present study. If there is another opportunity for that study, we would like to do it.

B: Agreed.

#### 11. Suspended load.

B: Mr. Kibria's comments (his document: Volume 4, 2, x), page 4).

No comments on the description in the Progress Study Report.

J:

J: It is an interesting problem to measure actually the average total bed load plus suspended load at the selected bridge site in the Jamuna River. In the study of the present project of bridge construction, we have no programme for it.

As BWDB has competent experience on suspended-load sampling as has been conducted at the Bahadurabad station, we recommend to conduct samplings at the sites downstream of Bahadurabad site. The data, if available, will be taken into consideration in our feasibility study.

B: Agreed.

## 12. Treatment of the Dhaleswari River.

J: According to information obtained in Bangladesh, the Dhaleswari has two offtakes and the upstream one which has been the main offtake is gradually being silted up and being replaced by the lower one. Based on the information, we are going to plan to close the upper offtake in case we plan the bridge axis between the two inlets of the both offtakes. Your opinion is requested in this respect.

B: The main offtake of the Dhaleswari still remains upstream. Therefore, if the upstream offtake is planned to be closed, a short-cut will be needed and it may create worsening of flood condition upstream of the bridge on the left bank side.

J: Agreed.

Are there any problems if the upper offtake is crossed by a bridge?

B: In such a case, there is a danger of diversion of the Jamuna or a major part of flood flow through the Dhaleswari in case of excessive flood back water effect of the bridge.

J: The effect of the back water is now under study and will be clarified soon.

## 13. Proposed bridge site.

B: Mr. Kibria's comments (his document; Volume 4, 3, page 5).

J: On the basis of the study on the stability of the channel, it has been found that the two sites, Gabargaon site and Sirajganj site, are preferable to the other two for bridge construction. Selection between the

two should be made from the viewpoint of other aspects such as construction cost and traffic volume.

B: The decision of the bridge site should be done after sufficient and rational investigation. From this point of view, hydraulic model test and more borings along the Jamuna River are requested to be added to the scope of works before the final decision of the bridge site will be made.

J: We believe that the studies we have made and we are going to make on geomorphology and river hydraulics will be enough to give data for determining the priority of the four proposed sites.

As this problem has relations with the whole schedule of the present feasibility study, it will be further discussed in the general meeting after this part meeting.

B: Agreed.

14. Diagram of river system of the Jamuna River and other rivers in its surrounding area.

B: Mr. Kibria's comments (his document: Volume 4, 4, 1), page 5).

J: According to Mr. Kibria's pointing out, some portion of the diagram (Fig.4-1) has been corrected.

15. Basic design discharge.

B: Basic design discharge and the allocation of design discharge were agreed (Mr.Kibria's comments -- his document: Volume 4, 4, 11), page 5).

16. Water levels at the Hardinge Bridge.

B: Mr. Kibria's comments (his document: Volume 4, 5, 1), page 5).

J: Water level at the Hardinge Bridge on page 80 and 83 are shown in R.L. datum which stands for Reduced Level and is used for water-level gaging at the Hardgine Bridge. In the study report at the second stage, the water levels will be expressed in P.W.D. datum so as to avoid confusion.

B: Agreed.

17. Surface slope of the Jamuna River.

B: Mr. Kibria's comments (his document: Volume 4, 5, 11), page 5).

J: The surface slopes shown in Fig.5-9 were used to calculate Manning's coefficient of roughness with the discharges at each site measured on different date. This fact may have caused the difference of surface slope along the Jamuna River as you mentioned in the comments.

Anyway, in the Interim Report water-level profiles in Fig.5-9 will be shown only for the reaches which are used for the calculation of Manning's coefficient of roughness.

B: Understood.

18. Ratio of mean velocity to surface velocity.

B: Mr. Kibria's comments (his document: Volume 4, 6, 1), page 6).

J: The ratio of mean velocity to surface velocity was calculated using the values of velocities actually measured at the four sites, upper two sites in braiding reach and lower two sites in meandering reach. The results have indicated no noticeable difference between them.

B: Understood.

19. Minimum river width.

B: Mr. Kibria's comments (his document: Volume 4, 6, 11), page 6).

J: The basic idea for minimum river width has been given on page 8 in Summary of Progress Study Report on River Training Works.

B: Agreed.

20. Back water effect and hydraulic model test.

B: Mr. Kibria's comments (his document: Volume 4, 7, 1) & 11), page 6).

In our opinion, the study you have done is not enough to decide bridge site and further study by hydraulic model tests are needed and will be competent approach for the decision. Therefore, we strongly request to conduct hydraulic model test in the site selection.

J: At the present when the definite plan for the river improvement works over the Jamuna River is not established, it is almost impossible to decide the bridge site after establishing the plan,



because of the shortage of time. With regard to the back water effect and other effects to the diversion channel due to the river crossing, the successive investigation is going on. The effect, if it might appear, should be taken into consideration on the design of bridge structure. We propose that the problem whether hydraulic model test for site selection is conducted or not is to be discussed in General Meeting.

B: Agreed on the last sentence.

21. Hydraulic model test studies.

B: Mr. Kibria's comments (his document: Volume 4, 7, ii), page 6).

J: Agreed.

22. Thalweg.

B: Mr. Kibria's comments (his document: Volume 4, 7, iii), page 6).

J: The location of thalweg at each site is shown in Figs.7-11-1 ~ 4 which are made out by soundings and is also confirmed by reconnaissance by boat and helicopter and aerophoto mosaics in 1970.

B: Agreed. In case of Sirajganj Site, the question on the effect of the proposed guide bank to the erosion of Sirajganj Town is to be studied in further detail.

J: The problem mentioned above should be studied at the stage of detail design.

23. Pitching stone.

B: Mr. Kibria's comments (his document: Volume 4, 7, iv), page 7).

J: As for the guide bank structure and its construction method, the described matters in the progress report are not final results of investigation, because availability of stone is not clear and many other factors are involved in this problem. Therefore, guide bank structure and its construction method will be studied in detail considering local materials and suggestions in your comment in next stage.

B: Agreed

24. Construction of guide bank.

B: Mr. Kibria's comments (his document: Volume 4, 7, v), page 7).

J: We are planning to construct the guide bank in the same method you mentioned in your comment.

B: Agreed.

25. Plastic mat

B: Mr. Kibria's comments (his document: Volume 4, 7, vi), page 7).

J: In Japan, plastic mat is used in practical construction works and is reported to fulfil its function sufficiently. Other advantages of this mat are the big strength and low price.

B: Agreed.

26. Construction of closing dike and embankment.

B: Mr. Kibria's comments (his document: Volume 4, 7, vii), page 7).

J: We are planning the construction of them by the same method you mentioned in your comment.

B: Agreed.

27. Construction in the river.

B: Mr. Kibria's comments (his document: Volume 4, 7, viii), page 8).

J: We are planning to construct closing dike and closing works in dry season with large capacity dredgers. We believe those works to be workable enough.

B: Agreed.

28. Scour at bridge piers.

B: Mr. Kibria's comments (his document: Volume 4, 8, page 8).

J: Agreed.

(4) TRAFFIC AND ECONOMY

On September 4, 1974 the part meeting of the economic and traffic survey took place between 11:00 am and 12:00 am. Messrs. L.Huq, G.Kibria, Md.Shafiullah and M.Rahman were in attendance. Mr. S.Asai presided at the meeting and Mr. K.Teshima explained the study process with flow diagrams and the contents of the Agenda, helped by Mr. E.Arai and Dr. Inose.

Some comments from the Bangladesh Committee were made clear and for the others further study was agreed upon.

The economic and traffic survey team had been supplied available data with the cooperation of the Government of the People's Republic of Bangladesh. But the survey team informed that they will need further information. To that the Bangladesh Delegates indicated that when the survey team visit the People's Republic of Bangladesh next, they would supply the whole volumes of the Draft Bangladesh Transport Survey Report submitted by the Economic Intelligence Unit. The Bangladesh Delegates also agreed to help in collecting information as far as available from the respective ministries and agencies on the items listed below (at pages 23 and 24 ), when some survey members visit Dacca at the end of September or the beginning of October 1974.

The comments concerned with our group have been carefully studied and our response thereto prepared in the succeeding pages.

The suggestion or advice raised by Mr. G.Kibria to study the feasibility report of SHAHJADPUR PORT by USAID was gratefully accepted.

There was a gap between our estimated traffic volume across the Jamuna and Mr. M.Rahman's rough estimate. After the meeting Mr. M.Rahman kindly promised to supply the data by analyzing "Daily Ticket Counts Book" and the record of freight wagons which crossed the Jamuna before the War.

A. Response to the Comments from Bangladesh

1. Comments by Mr. A.M.M. Ghulam Kibria

B: 300,000 ton diversion of IWT traffic to railway upstream of Aricha.

J: Our study of diverted traffic is downstream of Aricha -- between Chittagong and Khulna regions. This traffic will be thoroughly studied with the results of our "factory survey" which is now under way.

B: No appraisal made of the expected traffic from the mining development projects in the North-west region.

J: We know those projects as visionary schemes with no feasibility for the time being. However, we have raised these in the Agenda to be fully incorporated into the future traffic evaluation.

B: Jute traffic to Chittagong.

J: Difficult inquiries into the movement of, especially, jute, cement and fertilizer. Further survey will be done, however, reliable information sources should be needed from your side.

2. Comments by Mr. Mustafizur Rahman

Ref. No. MR/ENC/JBS/Advisor, dated 17, 8, 1974

B: Target year of bridge opening: 1990.

J: No special reason for using 1990 as the target year, which must be carefully elaborated in co-operation with the other survey teams.

We request that the expression of target year 1990 be deleted from the Report.

Ref. No. MR/ENC/JBC/Advisor, dated August 26, 1974

B: Possibility of enhanced trade with India.

J: Very important for our study. Raised in the Agenda for detailed information.

**B. Required Information**

**I. Short-range plans (in the Five Year Plan)**

1. At the end of the Five Year Plan period, the People's Republic of Bangladesh is supposed to be a surplus country of food grains.

- a. Surplus/deficit balance by district
- b. Food grains allocation systems
- c. Other agricultural products by district

2. Revision of transportation plans

Revised transportation plans with the completion of the Bangladesh Transport Survey.

3. Details of transport coordination plan to meet the shortage of the existing capacity based upon the economic cost.

**II. Long-range plans (after the Five Year Plan period: for more than 10 and 20 years)**

1. Transportation network

- a. New construction plan of railway
- b. Improvement or reconstruction plans of railway
- c. Road development plans
- d. Operation of Aricha road ferry

2. Foreign trade ports

- a. Role and function of Chittagong and Chalna with inland transportation pattern of commodities.
- b. Scale and realizability of a deep-sea terminal off Chittagong Port with the position of the said ports.

3. Mining development projects of the North-west region:

Jamalganj coal project  
Jaipurhat lime stone and cement factory project  
Ranipukur rock project

- a. Presence of the feasibility study report
- b. Estimated amount of deposits
- c. Proposed mining year
- d. Planned annual production
- e. Planned hauling destinations

4. Outline of manufacturing development plans in the north-west region, centering around Bogra.

Have the studies been completed?

5. Detail information of traffic with India including transit traffic by commodity, route and transport mode.

6. Accurate information of the rail traffic across the Jamuna:

a. Number of rail freight wagons crossed the Jamuna before the War: monthly and annually.

b. Average loading rate per freight wagon.

c. Analyzed data of the daily ticket counts book (DTCB) before the War.

7. The whole volumes of Bangladesh Transport Survey Report for the Japanese survey group.

(5) HIGHWAY

1. Route Location

J: The access road study team have prepared the alignment on a basis of giving priority to the retention of existing road facilities, the selection of river stability crossing site and avoiding marshes, according to principle that access road must be directness.

B: In addition to the above, we suggest taking account of geological and soil condition. And we also ask you to weigh the other pavement methods comparatively in pavement design works.

At this stage, as the selection of the best site among the four proposed sites is very important, we will design according to your suggestions after the selection of site.

2. Vertical Alignment

J: In decision of design high flood level, the study team have adopted the maximum flood height which was recorded last May, July 7, 1970 and which is also said the largest number in the recent years. Besides the whole alignment will be built with a minimum free-board of three feet above high flood level.

B: The flood discharge in 1970 recorded 2,700,000 cfs. However, you have adopted 3,100,000 cfs in design flood discharge for Jamuna River Bridge Construction Project. Therefore, you might adopt the data of 1954, 1970 and 1974.

The data of 1974 was unavailable for our study this time, therefore, we have been preparing design high flood level in accordance with the data of 1970. On getting the newest data of 1974, we will study in detail.

3. Bridge & Spillway Bridge

J: With relation to the length of bridges over the tributaries, we have prepared through the field survey and on photomosaic map. On the other hand, we have calculated and adopted the value 2% of opening ratio for the sillway bridge from inventory of existing spillway and bridge opening for Dacca-Aricha Road which identifies only all weather road in Bangladesh at a right angle to the Jamuna.



B: We are going to study whether the value 2% is reasonable or not.

We believe that we have to identify the opening of spillways after the identification of design flood discharge of tributaries. However, on the basis of presumption of 2% we should try to investigate at the second stage in order to reach the full-satisfaction.

#### 4. Road Section Composition

J: The highway will have two lanes, each eleven feet wide. The right-of-way is of sufficient width to permit construction of two additional lanes when traffic warrant it.

B: You have designed the highway with borrow pits on both sides, but we suggest one side borrow pits is enough to function as canal and to supply earth.

The Government of the People's Republic of Bangladesh shall take appropriate actions to reserve sufficient land for two additional lanes for future extension on the other side of the borrow pit and the road. None should be allowed any construction on such reserved land which can only be used for agricultural purpose. It is not necessary at this time to acquire this land. We will discuss the above mentioned with R & H at the second stage.

(6) RAILWAY

1. Route Location

B: Generally agreed. However, during the succeeding step it shall be studied for river crossing, embankment over low lying marshy lands, blockade of water way, highest flood level, connecting places of commercial importance, etc.

J: Due attention will be paid.

B: The reduction of the number of transshipment yards at way side place will be desirable from the point of view of rail operational efficiency.

A uniform gauge track line from the west through to Dacca will be wished to be maintained.

For this purpose the existing meter gauge line will have to be widened to broad gauge if one of sites No.1 and 2 is decided. All railway lines are to be taken to Dacca which is a terminal station.

J: Due consideration will be given to the transshipment facilities when the final route is decided, together with the volume of transportation and the improvement plans of the existing rail lines.

2. Double Track

B: The cross-sectional space for the future provision of double track from proposed single track shall be kept.

J: The traffic study has been and will be conducted. With the results of the study, double track plan will carefully be elaborated, taking into consideration distances between stations, required daily carrying capacity of the line, etc.

If the traffic study results reveal the necessity of double track in later years the possibility of a double track bridge which requires a huge amount of construction cost, will be fully considered in connection with the bridge structure.

B: Traffic will be projected for long future and provision will be kept in foundation and substructure of the bridge for putting in double track in the super-structure in some future days if economic study and traffic operation justify it.

J: Full consideration will be given.

### 3. Gradient of Bridge Access

B: The gradient 1 in 200 shall be flattened from the point of the train motive power. One in 300 or 400 is desirable.

J: Generally accepted. However, we will study more about this with the distance between stations and the location of stations, etc.

### 4. Provision for Railway Study

B: Second stage, study of access railway line may be conducted according to provision of Code of Practice for Engineering Department of Bangladesh Railway.

J: Agreed.

### 5. Structures and Earthwork

B: For embankment on Railway links, soil test, spillway bridges, flood openings, freeboard over high flood level, etc. should have the same considerations as those for road links. In case of a future double track, provision should be kept for borrow pits on one side only.

J: Agreed.

(7) FERRY

1. On the report on the survey of railway ferry.

B: Mr. Rahman's comment (viii in APPENDIX-II).

J: The study concerning the railway ferrys has been in good progress since the submission of the progress report. A summary of the study was submitted at the Tokyo meeting.

2. On the survey report by B.I.W.T. Corporation Ferry.

B: Mr. Kibria's comment (Volume 8).

J: The location of Teprakandi Ghat in the report on B.I.W.T. Corporation Ferry is based on I.W.T.A.'s sounding map (Sheet No. G 82/73 B), in which the location of the Ghat is clearly shown.

(8) BRIDGE

1. About preference of prestressed concrete bridge in main bridge.

The weight of prestressed concrete bridge is larger than that of steel bridge in long span bridge, therefore the reaction to substructure of the bridge is larger than that of steel bridge.

This means that the total cost of super and substructure will be higher than that of steel bridge and the estimated benefit cost ratio of prestressed concrete bridge will not be preferable.

The above stated item was agreed between two groups.

2. About navigation clearance for other rivers than the Jamuna.  
( on No.8 in "Agenda of the meeting" )

In the first stage of study navigation clearance shown in Table 3-1 (p.24) and Table 3-2 (p.25) of Progress Study Report on Bridge Planning will be used for design of rivers other than the Jamuna. But prior to the second stage of study the prearrangement about this item must be made with the competent authorities.

The above stated item was agreed between two groups.

3. As regards type of bridge foundation, it was discussed and agreed that caisson (well) foundation will be preferable to pile foundation due to its economy and facility of work.

**2. LIST OF PARTICIPANTS**

(1) Bangladesh Mission

Name	Occupation
Mr. A. Samad	Secretary, Ministry of Communication
Mr. Lutful Huq	Joint Secretary, Ministry of Communication
Mr. Golam Kibria	Chief Engineer, B.I.W.T.A.
Mr. Md. Shafiullah	Deputy Chief Engineer, R & H
Mr. Mustafizur Rahman	Engineer in Chief, BD. Railway

(2) Japan International Cooperation Agency

Name	Occupation
Mr. Masao Ohno	Head of Department of Social Development Cooperation
Mr. Shooshichi Miyazawa	Head of Development Surveys Division



(3). Japan Supervisory Committee

Assignment	Name	Occupation
Chairman	Mr. Toshiro Nagai	Ministry of Construction
Member	Mr. Toshio Iizuka	"
"	Mr. Akihiko Tsuchiya	"
"	Mr. Shigeyuki Watanabe	Science & Technology Agency
"	Mr. Masahiro Taniguchi	Ministry of Construction
"	Mr. Sadao Kishimoto	"
"	Mr. Ishio Kawasaki	Honshu-Shikoku Bridge Authority
"	Mr. Nirekichi Hirokawa	"
"	Mr. Tetsuo Kunihiro	Ministry of Construction
"	Mr. Hiroshi Yoshimura	"
"	Mr. Keiichi Komada	"
"	Mr. Shinichiro Asai	"
"	Mr. Tooru Nishiyama	"
"	Mr. Tamotsu Matsumura	"
"	Mr. Hidekazu Arai	"
"	Mr. Hideo Tokuhiro	"
"	Mr. Enakichi Abe	Japan Railway Construction Public Corporation
"	Mr. Shooji Miyashita	Ministry of Transportation
"	Mr. Takeo Kobayashi	"
"	Mr. Keiji Nishimura	Ministry of Construction
"	Mr. Toshitomo Kanakubo	"

(4) Japanese Study Team

Leader in General	Dr. Shizuo Inose
Leader of Geological & Quarry Survey	Mr. Masanobu Sakaita
Member	Dr. Zensuke Yoshida
"	Dr. Mitsuo Oyama
Leader of River Planning	Dr. Seichi Sato
Member	Prof. Masahiko Oya
"	Mr. Shoji Kawabata
"	Mr. Keiji Adachi
Leader of Traffic & Economic Survey	Mr. Yasuo Yanai
Member	Mr. Kunio Teshima
"	Mr. Nobuwaka Yamakawa
"	Mr. Shizuo Iwata
Leader of Highway Planning	Mr. Kunimura Nagashima
Member	Mr. Harumi Nishikawa
"	Mr. Kunio Ohashi
Member of Railway Planning	Mr. Susumu Shinozaki
Member of Ferry Survey	Mr. Junichi Shimada
Leader of Bridge Planning	Mr. Kaoru Tezuka
Member	Mr. Takeo Sakurai
"	Mr. Yoshihiko Wakabayashi
Leader of Field Surveying	Mr. Masao Kikuchi

APPENDIX - I

A G E N D A

In the course of the study, we have encountered several problems which, we think, have relations with the Bangladesh Government's policy. Some of them have to be solved at the first stage of the study or before finishing the Interim Report and others will have to be solved before proceeding to the second stage of the study or the stage of the Feasibility Study.

Those problems, we expect, shall be solved by the discussion in the Tokyo Meeting to be held in coming September. The subjects on them are shown below together with brief explanations.

1. Effective Width of the Bridge.

We propose an effective width required for one single track with broad gage and two lanes for highway because, according to the rough estimation at this stage, it is presumed that the traffic capacity of this width will meet the volume of traffic to be expected for the time being. If there is no objection from the viewpoint of communication policy, we want to obtain a consent from your side.

2. Minimum Width of the Jamuna River.

In the progress report on the river training, we have proposed a minimum river width principally judging from the natural aspect of the river. If there is no objection from the river management side, we want to use this width as the lower limit when we plan the length of the bridge.

3. Design Discharge for Bridge Construction.

Guide bank system is being considered as river control works for bridge crossing. Design water level is required to determine the elevation of the lower face of the bridge and the design discharge is required to determine the water level. The design discharge for bridge construction may have relations with that in flood control policy. If so and necessary, we must obtain a consent from the river management side with respect to the design discharge which has been proposed for the bridge project in the progress report.

4. Procurement of Stones.

The present project requires several million cubic meters of stones for pitching and concrete. However, it has become clear as the result of

the first investigation that the required quantity of stones does not exist in the land of Bangladesh. On the other hand, a prospective quarry site had been considered in Assam State, but no investigation was possible as the entry permission was not issued. We are therefore planning the second investigation on other prospective quarry than the above in coming dry season.

Even if we should be permitted to enter India to conduct our investigation, it is still doubtful to secure such amount of stones in a considerably short period. Anyway Bangladesh has to import them from the foreign countries since the required quantity of stones does not exist within the territory. What do you think about the possibility of import? If the import is possible, what do you think about the transportation and the unit price of them?

#### 5. Route Location of Railway Links.

In the progress report, we have proposed the route of the railway links which were located in connection with each site for the bridge crossing. If there is no objection from the viewpoint of the railway policy, we want to obtain a consent from your side with respect to the proposed route.

#### 6. Gage Length of the Railway Links.

As is seen in the progress report, we have planned single-track railway with broad gage on the whole link lines in connection with each site for bridge crossing. This was made in connection with the gage which has been adopted for the bridge planning on the basis of the Minutes of the Meeting held in Dacca on August 8, 1973. If there is no objection from the viewpoint of the railway policy, we want to obtain a consent from your side.

#### 7. Route Location of Highway Links.

In the progress report, we have proposed the routes of the highway links which were located in connection with each site for bridge crossing. If there is no objection from the viewpoint of the highway policy, we want to obtain a consent from your side with regard to the proposed route.

8. Navigation Clearance for Other Rivers than the Jamuna:

The Jamuna Bridge is being planned in consideration of the navigation clearance presented by the Bangladesh Government. Since the standard of clearance is not presented for other rivers than the Jamuna, we propose the clearances for them as mentioned in the progress report on the bridge planning. If there is no objection from the viewpoint of inland navigation policy, we want to obtain a consent from your side.

9. Information to be Required for Further Development of the Study on Economy and Traffic Volume.

The following information is required to develop further the study on economy and traffic volume. If possible and in time, it is requested to bring them to the Tokyo Meeting.

(1) Information in connection with the Five-Year Plan.

a. Surplus of agricultural products.

Demand for food grain and role of the North-West Region -- local surplus and deficit, although the Five-Year Plan states national surplus.

(2) Information in connection with the long-term or fundamental plans other than the Five-Year Plan.

1) Network.

a. Network plan (conception) of roads and rails after the Five-Year Plan period (chronological): the level of improvement after 10 and 20 years and future plans of new routes.

b. Operation of road ferry.

- especially for the Aricha ferry: measures to counter the vehicle traffic which has been growing rapidly.

2) Foreign trade ports.

a. Fundamental plan of the ports of Chittagong and Chalna  
- especially their roles:

1. regional (longitudinal) allotment under the two ports' charge, e.g., eastern region for Chittagong Port and western for Chalna Port.

ii. functional allotment, e.g., imports for one port and exports for the other.

b. Third port plan:

scale and realizability of a deep-sea terminal off Chittagong Port.

3) Development policy of the North-West Region.

- realizability of mining of lime-stone and coal after 10 and 20 years.

4) Inland manufacturing in the North-West Region.

development plans of manufacturing industries centering around Bogra.

5) Traffic with India.

Coal is imported from India at present. Possibility of enlargement of trading with India for other commodities and developments of a connection with the Calcutta industrial areas.

APPENDIX - II "

BANGLADESH SIDE'S COMMENTS ON  
AGENDA AND PROGRESS STUDY REPORTS



BANGLADESH RAILWAY

No. MR/ENC/JBC/Adviser

August 26, 1974

From: Mustafizur Rahman  
Engineer in Chief  
Bangladesh Railway  
Chittagong

To: The Secretary  
Ministry of Communications  
Road Division, Foreign Aid Branch  
Dacca

Sub: JAMUNA BRIDGE ADVISORY COMMITTEE

Ref: Your No.FA/IV/M-14/74(Pt)/1/534(7)  
dated 23rd August, 1974

By comments on your Memo, No.FA/VII/M-14/74(Pt)/490(7) dated 10-8-74' has already been submitted under my letter of even number dated 17-8-74'.

My comments on the Agenda for ensuing Tokyo meeting is noted below seriatim:

Agenda-1 of Tokyo meeting:

Effective width of the bridge:

Single Track Broad Gauge Railway has been proposed for the time being. It is seen from the progress study report on economic and traffic survey that considerable traffic will be generated after the bridge is opened in the year 1990. To cater for this increased generated rail borne traffic for years to come after opening of the bridge, it is considered necessary to construct the bridge and the access railway as Broad Gauge Double Track.

Existence of long block sections due to unusual length of the bridge will reduce the traffic hauling capacity of the single line drastically. This also necessitates construction of a double line over the bridge as well as on the Railway access links for smooth transportation and to avoid bottle necks in running of trains.

As noted in the Bridge Planning Report Studies in this respect is still in progress and further will be reported in Tokyo meeting.

#### Agenda-4:

##### Procurement of stones:

On the north of Jamalpur sub-division in the district of Mymensingh, in an around a place called Rangtia, there is huge deposit of stone materials of smaller sizes.

##### Procurement of stones contd:

In the past international Geologists have surveyed the area and gave an estimate to the Government. The details of the report may be available with the Geological Survey Department.

It is seen that survey of a railway extension upto Rangtia either from Jaria-Jhanjail or from Jamalpur Railway Stations was proposed in the past to tap the source for development activities in the country.

It is requested that during that second stage survey details of the deposit may be further studied. If the required quantity is available we may think of manufacturing artificial boulders and concrete blocks for guide bank pitching and other river protection works.

Before taking a decision for importing boulders, we should examine all the local resources. This will save huge cost of transportation.

#### Agenda-5:

##### Route location of railway links:

This may be agreed generally. After selection of the most suitable site, the access link may be thoroughly studied for river crossing, embankment over low laying marshy lands, blockade of water-way, highest flood level, connecting places of Commercial Importance etc.

Second stage study of access railway link may be conducted as per provision of code of practice for Engineering Department of this Railway.

#### Agenda-6:

##### Gauge length of Railway Link:

This should be for Double-line Broad Gauge Track.

Agenda-9 (5):

Traffic in India:

There is possibility of enhanced Trade with India and there is probability for establishing a connection with Calcutta from Dacca over the bridge.

Movement of rail borne traffic between Agartala and rest of India should be studied in the second stage of Traffic Survey as this traffic will move over the bridge. Presently, this traffic has been calculated to be about 150 thousands tons a year.

Above comments are in continuation to those submitted vide my letter of even number dated 17-8-74.

Sd/- MUSTAFIZUR RAHMAN  
Engineer in Chief  
Bangladesh Railway, Chittagong

Copy to General Manager, Bangladesh Railway and Secretary Railway Division for information. This has reference to our discussions on the above subject.

Sd/-  
Engineer in Chief/CRB

Registered with A/D

Bangladesh Railway

From: The Engineer in Chief  
Bangladesh Railway  
Chittagong

To: The Secretary  
Ministry of Communications  
(Road Dev. & Foreign Aid Branch)  
Dacca

Ref. No. MR/ENC/JBS/Adviser

Dated: 17.8.1974

Sub: Jamuna Bridge Advisory Committee

Ref: Your No.FA/VII/N-14/74(pt.)I/490(7)  
Dated 10.8.74

My comments alongwith notes on different subjects and conclusion are enclosed herewith. This may please be included in the working papers under preparation in your office for the ensuing meeting of the advisory Committee as referred to, in your letter under reference.

Encl.: As above in four sheets

(Mustafizur Rahman)  
Engineer in Chief  
Bangladesh Railway  
Chittagong

## JAMUNA BRIDGE CONSTRUCTION PROJECT

### First Stage

#### Comments:

The following 9(nine) Study Reports have been received and gone through:

- (i) General Progress Study Report
- (ii) Progress Report on Surveying
- (iii) Progress Study Report on Geological Survey
- (iv) Progress Study Report on River Training Works
- (v) Progress Study Report on Economic and Traffic Survey
- (vi) Progress Study Report on Railway Links
- (vii) Progress Study Report on Highway Links
- (viii) Progress Study Report on Ferry Survey
- (ix) Study Report on Bridge Planning

#### (I) General Report

4 (four) probable sites have been selected on the basis of previous report of Mr. Ishio Kawasaki. These are;

- (a) Down stream of Bahadurabad
- (b) Near Gabargaon
- (c) About 10 km down stream of Sirajganj
- (d) About 20 km up stream of Aricha

Nearly similar sites were also recommended by Mr. T.Hashimoto, Leader of Japanese Reconnaissance Team on the 8th May, 1972.

After the most suitable sites, out of the above four, are selected in meetings at Tokyo and Dacca between the OTCA and Bangladesh Experts, interim report will be submitted.

On receipt of approval of the Government of the People's Republic of Bangladesh to the above interim report, the second stage survey and investigation will be undertaken immediately after. In the second stage, more detailed studies on the most suitable bridge sites will be carried out. This will also include benefit cost studies.

Feasibility Study Report is scheduled to be presented by OTCA at the beginning of August, 1976.

## (II) Report on Surveying

First stage report is scanty. Details are wanting. Maps have not been shown in the report.

Second stage programme does not seem to be sufficiently elaborate. Period may be continued upto June and more time may be allowed for each item:

## (III) Report on Geological Survey

Reconnaissance trips in Asam State were refused by Indian Govt. on the ground of security. Stone deposit in Asam may be surveyed during second stage survey.

From the view points of pile supports; the sites 2 & 3 are more preferable.

## (IV) Report on River Training Works

On the basis of Geo-morphology, the Sirajganj site is considered to be the best and Nagarbari site is the worst.

On the basis of river morphology, the first three sites stand for equal chance while the Nagarbari site is worst.

## (V) Report on Economic and Traffic Survey:

Target for opening the bridge has been fixed as the year 1990. Over-all traffic across the Jamuna in 1990 is estimated 1,700,000 tons a year approximately.

According to existing regional structure, case 1 & 2 are the best. Case 3 can be included in this group.

From the view point of distance between Dacca and Khulna which are the centres of economic activities, case 3 & 4 are desirable.

Industrial activities and prospects of economic growth near about Bogra, on the basis of minerals and coal prospects at Jamalganj; case 2 is most preferable.

For connection between Calcutta and eastern region of Jamuna bridge; case 4 followed by 3 is preferable.

It appears 14 years (1976-1990) will be required for detailed design, plan and construction of the bridge and access ways. The time seems to be too long. A schedule for the work against time may be programmed for consideration of the Committee.

(VI) Report on Railway Links

All important details are available in Appendix 'A' i.e. summary on Railway approach line.

Maximum gradient 1 in 200 seems to be too steep for long stretches indicated on two ends of the bridge. This should either be flattened or the length should be shortened keeping levels for breathing.

(VII) Report on Highway Links

If it is decided to make it a Road-cum-railway bridge, the Railway and the Road may be allowed to remain on the same bank as far as possible unless they are to be diverted for connecting obligatory points or important arteries. Combined plans showing the regime of access for Rail and Highway may be prepared.

(VIII) Report on Ferry Survey

No reports have been made on railway ferry. These are under study. Report on railway ferry should be made available as early as possible.

(IX) Report on Bridge Planning

It has been noted that rail-cum-highway bridge will provide double the benefit cost ratio on that of highway bridge.

It is requested that OTCA may also calculate the benefit cost ratio of rail-cum-highway bridge over that of a railway bridge.

Width of bridge, structural type of main girder and foundation -- results of study will be discussed in Tokyo meeting.

CONCLUSION:

From the view point of railway transportation and also in consideration of the geological, economic, traffic and feasibility of highway link, case 3 i.e. Sirajganj site is considered to be the most suitable for a rail-cum-highway bridge of river Jamuna.

The Sirajganj alignment as has been shown in the plan will help development of new country side and connect important places like Tangail with the rest of the railway system. This alignment will avoid transshipment points at intermediate junctions.

The points noted above, comments and conclusions are based on the study reports in hand. Reports on remaining studies may also be made available as soon as possible.

Encl.: One (Appendix 'A')

Mustafizur Rahman  
Engineer in Chief  
Bangladesh Railway  
Chittagong

SUMMARY OF RAILWAY APPROACH LINES

Site Number & Nomination	No. 1	No. 2	No. 3	No. 4
Originating Station and its Location	Bahadurabad Velurpara on Santahar- Bonarpara Line	Gabargaon Bogra on Santahar- Bonarpara Line	Sirajganj Salap on Ishurdi- Sirajganj Line	Nagarbari Gooakhara on Ishurdi- Sirajganj Line
Terminating Station and its Location	Durmat on Jamalpur- Bahadurabad Line	Jafar Shafee on Jamalpur- Jagannathganj Line	Azampur (or Tungi) on Dacca-Tungi Line	Azampur (or Tungi) on Dacca-Tungi Line
Total Length of Line (km)	38	55	114	120
Gauge	Broad (5' - 6") 1,676 m	Broad (5' - 6") 1,676 m	Broad (5' - 6") 1,676 m	Broad (5' - 6") 1,676 m
Number of Tracks	Single	Single	Single	Single
Major Station	-	-	Tangail Station	-
Number of Minor Stations	2	5	10	11
Allowable Maximum Gradient	5/1,000	5/1,000	5/1,000	5/1,000
Minimum Curve (meters)	R = 1,000	R = 1,000	R = 1,000	R = 1,000
Bridge	780	1,200	1,080	3,360
Running Length (m)	90	180	450	390
Earthwork up to Formation (m)	2,077,000	3,319,000	5,618,000	6,385,000



COMMENTS ON THE PROGRESS STUDY REPORTS (IN 9 VOLUMES)

FOR JAMUNA RIVER BRIDGE CONSTRUCTION PROJECT

(FIRST PHASE)

PREPARED BY O.T.C.A., GOVT. OF JAPAN (JULY, 1974)

By: A.M.M. GHULAM KIBRIA  
Chief Engineer  
Biwta, Dacca

&

Member, Jamuna Bridge  
Advisory Committee

VOLUME 1 (GENERAL PROGRESS STUDY REPORT)

No Comments.

VOLUME 2 (PROGRESS REPORT ON SURVEYING)

While agreeing to the outlines of the methods followed in hydrological survey, it is not clear why the scale of 1:30,000 for new aerial photos (to be taken) has been recommended (page 5). This is in view of the fact that all the existing photomosaics (of aerial photos) are in 1:50,000 scale. The views of the survey of Bangladesh may be obtained on this point in particular and the aerial photos as well as topographic maps (to be prepared) in general.

As per item (5-4) on water level observations (page 6) it may please be clarified that whether the second stage survey will cover only three points out of the four tentative points viz Bahadurabad, Gabargaon, Sirajganj, and Nagarbari (Bera).

VOLUME 3 (PROGRESS STUDY REPORT ON GEOLOGICAL SURVEY)

No comments excepting an interpretation of the Geological Profile (enclosed with the progress report) may be given as to whether 1) the absence of gravel and boulder stratum (At.) in the bore holes B-0 (Bahadurabad) and G-0 (Gabargaon) indicates the movement of these gravels and boulders by ice from the direction of the Garohills (north of Jamalpur) where glaciated could have existed in the last iceage period, movement of such thick layers

of boulders/gravels by water as outwash materials from the moraines at the foot of the Garohills being apparently not possible.

And ii) the hard clay (DL 2) is consisting of glacial boulder clay.

#### VOLUME 4 (PROGRESS STUDY REPORT ON RIVER TRAINING WORKS)

1. The following comments are given:

##### 1. GENERAL

All data may be given in F.P.S. system for better comprehension in Bangladesh.

##### 2. CHAPTER II

1) in the figure 2-4 (page 10), the extensions of the hill ranges from Tripurah (India) into southern parts of Sylhet district as well as the Sitakunda and Satkania hill ranges have been wrongly shown as consisting of "fan" (alluvial fan) materials. This should be corrected.

Besides, the glacial moraines at Tetulia (north-western-most tip of Dinajpur Dist.) and at Sandhyakura deposits north of Mymonsingh have not been shown and have been grouped in "fan" materials.

Also the "Tidal Areas" have not been covered properly and the distinction between the "Flood Plain" and the so-called "Delta" is not clear. The distinction between the "Tidal Areas" and "Coastal Plains" may be defined.

ii) Page 11 The division of the Jamuna into (i) Upper reaches with characteristics of those in the alluvial fan and (ii) lower reaches with characteristics of those in a "natural levee region," appears to be interesting. Does it mean that the upper reaches (above Sirajganj) with an average W.L. gradient of 1:13,000 form a braided channel and the lower reaches with an average W.L. gradient of 1:20,000 form a meandering channel.

iii) Page 11 (Last para)

Subsidence of the Coastal belt in the later part of Holocene and the subsequent marine transgression giving rise to the mangrove swamps (Sunderbans) in the Coastal belt has not been mentioned.

iv) Page 12 The effect of the esthetic rise of sea levels in the Post Pleistocene epoch has been excellently incorporated. It may be explained as to whether the glacial boulders and gravels were carried in the last iceage from the Himalayas across Dinajpur and Bogra or from the Garohills across Jamalpur, no such gravel/boulder layers being present at Bahadurabad or Gabargaon.

v) Page 14 (Shifting of the Ganges River) and Page 15 (Shifting of Brahmaputra - Jamuna River)

The influence of the movement of the deep seated faulty along N.W. - S.E. direction (i.e. aligned along the Indonesia or Burma Trench) and the same along (N.E. - S.W. direction i.e. aligned along the deep canyon viz the Swatch of No Ground) as well as Secondary faults created by these principal faults and the East West Faults apparently created by massive creep of the Coastal belt of Bangladesh, appear to have not been considered by the writer.

vi) Page 19 (Bahadurabad and its vicinity)

Why should have the two alluvial fans developed as long narrow strips along the left banks - is it because of flatter gradient and constraint from the right bank levee of the Old Brahmaputra? What about the formation of the alluvial fan on the right bank? This as per Fig.2-7 (page 20) appears to have developed into a long narrow strip parallel to the Jamuna.

What will be the effect of the (a) proposed bridge with river training at Bahadurabad, Gabargaon, Sirajganj, (b) Brahmaputra right bank embankment as well as (c) any future left bank embankment on the further development of this fan and braiding pattern of the Jamuna itself upto Sirajganj.

vii) Page 24 (para 2 & 4)

In para 2 & 4 it has been mentioned that "based on the above-mentioned studies on the geo-morphological land classification, Sirajganj is the most stable place, "although it has been mentioned in the last sentence of page 22 that "there are possibilities of shifting of the river courses in the alluvial fan region i.e. in Bahadurabad and Gabargaon region".

In other works if there is a shifting of the river course through any course, the bridge at the said "stable" site at Sirajganj will remain high and dry.

This also indicates the need for training of the Jamuna upto Sirajganj in order that no such avulsion may take place in so far as the bridge site at Sirajganj is concerned. As such it is considered that the judgement on the Bahadurabad, Gabargaon and Sirajganj sites (as per para 2, 4 & 6 of page 24) is not a final one and is dependent on several constraints referred to above.

viii) Page 25 - Changes of bank lines

a. Changes of bank lines

The conclusion on the Sirajganj, Gabargaon and Bahadurabad sites (in para 4 of page 25) is agreed upon in view of the studies made.

b. Changes of Chars and Thalwags

Agreed.

c. Changes of cross-sections

Agreed.

ix) Bed Materials (pages 31 to 41)

The conclusion that 1) D65 (0.17 mm) is constant is interesting.

Agreed.

x) Suspended Load (page 41 to 50)

No comments.

The average total bed load plus suspended load at the selected bridge site in the Jamuna for at least two years may be found out (by the Japanese experts in the 2nd stage survey) based on actual measurements.

3. CHAPTER III

Page 51 (Proposed Bridge Sites)

While I agree to the conclusion No.(2) in para 2 of page 51 regarding the Nagarbari site, I am of the opinion that as already mentioned in my comments, apropos page 24 (para 2 & 4), no final conclusion on selection of the Sirajganj site is possible without examining all the points referred to by me.

#### 4. CHAPTER IV Design Discharge (page 52 to 70)

- 1) The diagram (in Fig.4-1 on page 53) showing the river system of Bangladesh is not correct in so far as the Bansi River in Mymensingh Dist. (east of the Jamuna) and the Mathabghanga River (wrongly written as the Kobadak) taking off from the Gange are concerned.
- ii) The basic design discharge of 3,042,000 c.f.s. with a return period of 100-year is agreed upon (page 66 para 4).

But as regards the allocation of the design discharge, (para 6 of page 66) it may be pointed out that this essentially pre-supposes that

- a) the Old Brahmaputra Offtake will be closed with an control structure allowing a discharge of only 30,000 c.f.s. during the low water as well as high water stages, b) there will be embankments on both banks of the Jamuna (from the hill on Indian border) with proper training works so that Jamuna will not be allowed to forsake its channel and move into any other channel including the Old Brahmaputra.

This point appears not to have been sufficiently clarified, as not only the design of bridge openings and river training works, but the very location of the bridge pivots on this vital factor.

#### 5. CHAPTER V Coefficient of roughness (page 71 to 80)

- 1) In Table 5-2 in page 80 and Table 5-3 on page 83 the water levels of the Ganges at Hardinge Bridge have been unnecessarily increased by 200 ft. This is misloading and should be deleted.
- ii) The water surface profile (vide figure 5-9 on page 87) is interesting, as it shows the sharp change of gradient (d/s of Gabagaon) from about 1:13,000 to about 1:26,000. But increase of this gradient to about 1:23,000 further downstream at Nagarbari is not clear and calls for explanation.

#### 6. CHAPTER VI Minimum river width

- 1) Apropos of page 93 should  $\frac{v_m}{v_s}$  be the same for the entire Jamuna River - braided reach as well as the meandering reach d/s of Sirajganj?
- ii) The deviation of the minimum width ( $W_{min}$ ) as 3,900 meters (vide para 3 of page 93) as well as the last sentence of page 95

Call for further elucidation

It is not clear from the Fig.G-1 of page 92.

## 7. CHAPTER VII Guide Banks

- 1) As regards the three types of width for the bridge viz Type-A (2,000 m), Type-B(4,000 m) and Type-C(varying from 5,200 m at Sirajganj and Bahadurabad sites to stoom for the other two sites) it is recommended that the type may be accepted for the bridge width as well as the design of guide banks, on order to minimise the scouring at the bridge site and the backwater effect.

It may be pointed out that while the maximum scourings in design of the guide banks and bridge piers for different width at the four proposed sites have been elaborated in page 131 to page 134, backwater effects due to construction for different bridge width at the said 4 sites have not been given. As this rise of water level due to backwater effect (or afflux) is of much importance in future design of the flood embankments on the Jamuna, this may be elaborated in all the cases.

### ii) Hydraulic Model Studies

I fully endorse the view that the final design of the guide banks should be based on proper hydraulic model studies and not on any empirical formula.

- iii) From the figures 7-2-1 (Nagarbari site on page 102), 7-2-2 (Sirajganj site on page 103) and 7-2-3 (Gabargaon site on page 104), it is seen that the guide banks have been designed keeping the left bank (east bank) fixed, while for Bahadurabad site (Figura 7-2-4 on page 105) the reverse is the case. This calls for further elucidation in view of the fact that all along the length from d/s of Bahadurabad site to Hagarbari the Jamuna appears to be attacking the right bank (Fig. 2-12-1 on page 30).

### iv) Thickness of pitching stones for apron (last para in page 135)

It may be clarified why articulated concrete mattress or stone rip-rap encased in wire netting should not to preferable to loose stones in the falling apron of the guide bank, so that the length of the articulated concrete mattress or rip-rap encased in wire-netting could be designed for the maximum length of scouring. This is considered to result in economy of stone.



v) Diagram of overall apron of Guide Bank (page 136)

It is suggested that the body (i.e. the dike proper) could be built of dredge filled river sand so as to minimise unequal subsidence.

vi) Standard Cross-Section of Guide Bank (Incase of Deep Water)

Fig. 7-10 on page 139. In the proposed construction suggested in deepwater with strong current, it is suggested that good clay (preferably boulder clay) may replace the plastic mat seat which is likely to be perforated or displaced in the placing of material and result in loss of sand from the body of the dike.

vii) Location of Guide Banks, Closing Dikes and Closing Works (page 141 to 144)

It is suggested the portion of the river which will be closed by closing dikes may be filled in by dredgers which should also be used in building the road and rail approaches for the bridge. This will save a considerable area of land from being excavated. Although dredging quantities have been mentioned in the rough estimates in this report, volume, specific places, where dredgers and type as well as member of dredgers have no where been mentioned. This should be specified.

viii) Standard Cross-Section of Closing Works (Fig.7-12 on page 145 and Fig. 7-13-2 on page 147)

The method proposed appears to be not workable in strong current in sandy bed. It is suggested that protection of the bed upto sufficient distance (based on hydraulic model or experience) with fascinemattress or plastic/nylon/coaltared jute mat (fixed with heavy weights) should be resorted to. The best means to close appears to be by sinking of floating concrete caissons and then dredge filling to cover the same.

## 8. CHAPTER VIII SCOUR AT BRIDGE PIERS

Type and depth of the piers which -- in my opinion should have the same depth in view of unstable nature of the channel -- should be designed on detailed hydraulic model studies considering all the hydraulic parameters and the grainsize of the suspended as well as bed materials. These may not be designed as on theoretical computations only.

VOLUME 5 (PROGRESS STUDY REPORT ON ECONOMIC AND TRAFFIC SURVEY)

1) Summary

1) Page 4 (last para)

It has been assumed that 300,000 tons of IWT traffic will be diverted to railway across the proposed bridge. The IWT traffic concerned may be elaborated. It may be added that very little east-west IWT mechanised traffic involved at present in so far as the areas upstream of Aricha are concerned.

11) In general it may be added that the economic and traffic study has made no appraisal of the expected traffic from the proposed limestone quarry and cement factory at Jaipurhat as well as the proposed coal mine at Jamalganj. Also no consideration to the increased traffic due to any future mining of igneous rocks from the Ranipukur quarry south of Rangpur has been given.

2) CHAPTER II (page 19, para 6)

What happened to this traffic of jute to Chittagong?

This may be elaborated.

VOLUME 6 (PROGRESS STUDY REPORT ON RAILWAY LINKS)

No comments.

VOLUME 7 (PROGRESS STUDY REPORT ON HIGHWAY LINKS)

Chapter IV-2 (Navigation Clearance)

The navigation clearances in Bangladesh in so far as railways and highways are concerned are clearly defined in IWTA's Map on vertical and horizontal clearances which should be followed, as called for. In so far as channels (page 22) which are not given in the said map, viz Bangali River, Korotoa River (upstream of Bogra Town) and Chatal River a minimum vertical clearance of 12' and horizontal clearance of 100' for the navigation span may be provided, while for the other minor channels a minimum vertical clearance of 6' may be provided. In all cases of such the minor bridges clearance from the Chief Engineer. Irrigation may be taken in so far as drainage requirement is concerned.

VOLUME 8 (PROGRESS STUDY REPORT ON FERRY SURVEY)

CHAPTER III (BIWTC Ferries)



Page 16 (para 2)

The Tepurakandi ferry is situated on the main Padma and not on the secondary water channel, as mentioned in the report.

The report is otherwise quite comprehensive and covers all aspects of ferries/ferry terminals.

VOLUME 9 (STUDY REPORT ON BRIDGE PLANNING)

1. General

All data should be given in F.P.S. system for better comprehension and co-ordination with other economic studies in Bangladesh.

2. CHAPTER II PAGE 14 (Pier Depth - para 2)

Regarding the equal depths for all the piers, this is agreed.

3. CHAPTER III

i) Superstructure - Minimum horizontal navigation clearance is 250.

As such any of the three proposal will be acceptable, if a minimum vertical clearance of 40' is provided for.

ii) Substructure (para 3) - Further clarification on "less scouring or/ around the pier" in case of piers consisting of Pilegroups is called for.

4. APPENDIX A (Item-I)

It is proposed that all data/measurements should be in F.P.S. (Foot-pound-Second) system to keep harmony with other economic studies and better comprehension in Bangladesh.

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH  
GEOLOGICAL SURVEY OF BANGLADESH  
Pioneer Road, Segun Bagicha  
Dacca, Bangladesh

No.P & I-GNL(42)/74

August 15, 1974

Mr. S.S.M. Lutful Huq  
Joint Secretary  
Ministry of Communications  
(Roads, Ports, Road Transport)  
Government of the People's  
Republic of Bangladesh, Dacca

Sub: Jamuna Bridge Advisory Committee

Reference your memo N; FA/VII/M-14/74(Pt)/1/490/(7) dated 10th August, 1974 on the above subject. My comments on the Progress Study Report on Geological Survey for Jamuna Bridge Construction Project First Stage are as under:

Sub-surface Geological Study

The subsurface geological conditions have been indicated on the basis of only one drill hole at each of the four possible bridge sites and in site mechanical tests and laboratory tests on drill samples collected. The information available in Geological Survey of Bangladesh agrees in general with the conclusion drawn. For further information-any drill hole logs of deep holes (above 300' deep) in the vicinity of the proposed sites, that may be available with the Water Board, Power Board, and Agricultural Development Corporation, should be consulted.

The continuity of the various subsurface geological units as shown in Fig.S-1 is questionable due to absence of any data from areas in between the four possible bridge sites.

The lithology etc. of the units classified as "Diluvium" suggests that these may possibly belong to Dupi Tila formation of Pliocene age- in which case they would have more uniform compactness and better foundation conditions.

The continuity of geological unit AII (gravel & boulders), which may be a deciding factor in selection of one bridge site can possibly be confirmed by electrical resistivity survey.

### Rock Material Survey

In our opinion, the Bholaganj source can supply not only the concrete aggregate needs of the bridge project, but also a part of the boulder material required for bank protection etc.

Another likely source in the future may be the Madhyapara region of Dinajpur district. Here the Geological Survey of Bangladesh has proved the existence of hard Archaean rock formation at a depth of about 500 feet from the surface. If this can be mined, an inexhaustible source of supply of excellent concrete aggregate as well as large size blocks of rocks would be opened up. The Geological Survey of Bangladesh has completed 3 drill holes this year and will complete another early next Winter. On the basis of the data collected the BMEDC will prepare a feasibility report of large scale mining next year.

I would like to mention that as very little data is available in Geological Survey of Bangladesh concerning the subject matter of the other reports, I would not be in a position to offer comments on the other reports immediately.

Sd/-  
(Mesbahuddin Ahmed)  
Director General

COMMENT ON PRELIMINARY  
REPORT OF JAMUNA BRIDGE

ROAD SECTOR

**Approaches:** Road links to all the tentatively selected four sites have been discussed in the report. No preliminary ground survey has been conducted as construction of Road way approaches is feasible from the general study of the terrain. But the total length of embankment with structures thereon varies from site to site. The study shows the minimum length and structures are involved for site No.3. It also seems that site No.3 has a reasonable potentiality for road traffic in all the five districts of Rajshahi Division.

**Bridge sit:** Preliminary study reveals all the sites are more or less suitable for bridge construction and every site requires river training works. But site No.3 seems preferable as the river bank line movement is almost constant for a considerable long time and a reliable good bearing strata is available at a lesser depth.

**Design**

**criteria:**

- (1) Three types of crossing has been discussed of which B type may be considered as it will have unrestricted design discharge through the bridge cosequently having less trouble with scour on the bridge doudnation and protective works.
- (2) Prestressed concrete bridge is preferred as it involves less foreign exchange and minimum maintenance cost.
- (3) Carriage way of 38 ft is suggested with no provision for future extension which involves extra cost.
- (4) Rail-cum-Road bridge is suggested for comparatively less cost.
- (5) Possibility of using concrete Blocks pitching for protection works on guide banks and closing works for non availability of Boulder in the country may be studied.

- (6) Well foundation (cassion) seems more suitable as we are practising it for a long time.
- (7) Herring-Bone bond on sub-base is not necessary as it does not add any strength to flexible pavement where interlocking is the main consideration.

Sd/-

(md. Shafiullah)

Deputy Chief Engineer  
Roads and Highways

C O M M E N T  
ON  
DRAFT STUDY REPORT  
RIVER TRAINING WORKS  
FOR  
JAMUNA BRIDGE PROJECT

Cope of the study report covering all aspect of hydrology and river regime is not available. As such this comment covers only the following chapters available.

- |                 |                          |
|-----------------|--------------------------|
| i) Chapter IV   | Design discharge         |
| ii) Chapter V   | Co-eff. of roughness     |
| iii) Chapter VI | Minimum river width      |
| iv) Chapter VII | Design high water level. |

1. "To clarify whether water level is affected by variation of river bed, annual variation of water level of several frequencies was examined making use of the data obtained at Bahadurabad, Sirajganj and Kadamtali Stations." Graphical representation of this has been shown in Fig. 4-3, but not comment has been given if it reveals any variation in water level due to changes in river bed.

In contrast to other two stations the graph of Bahadurabad however indicates a gradual rise of L.W.L. over the past years.

This gradual rising of lowest water can be more clearly demonstrated by the 5-yearly moving average and its graphical representation as enclosed (Fig. I).

Lowest water level at Bahadurabad  
1949-1970

<u>Year</u>	<u>Date</u>	<u>Min. W. L. ft. P.W.D.</u>	<u>5-years moving average</u>
1949	27/2	37.45	
1950	28/2	39.90	
1951	19/2	40.00	38.55
1952	24-26/2	37.40	39.02 Lowest water
1953	23-25/2	38.00	39.22 level increasing at the rate of 29
1954	19-20/2	39.80	39.02 ft. i.i.e. 3 1/2 inches/year
1955	18/3	40.90	39.57
1956	-	-	40.57
1957	-	-	41.30
1958	22-24/2 2-3/3	41.00	41.32
1959	19/2	42.00	41.01
1960	24-26/2	40.95	40.65
1961	2-3/3	40.10	40.77
1962	20-26/2	39.20	40.46
1963	28/2	41.58	40.83
1964	-	-	41.61
1965	16-17/3	42.43	42.66
1966	8/3	43.20	43.18
1967	12/2	43.42	43.34
1968	28/2	43.64	43.47
1969	24-25/2	44.00	
1970	23.2	43.00	



Though the rising trend of L.W.L. is quite clear, it still remains to be stated the cause of this trend.

2. Fig.4-4 shows the statistical longitudinal water surface profile for the year 1968/69.

The difference of 355 day-W.L. and the L.W.L. at each of the station is insignificant except for the station Porabari. In the report this has been explained as due to the fact that the gauge of Porabari is located at the offtake of Dhaleswari. This comment cannot be accepted unless it is supported by the water levels of other years.

It is quite possible that the lowest W.L. of the station was wrong due to some reason.

3. Figs.4-3 and 4-4 as it seems were intended to reveal the long term variation of water level due to changes in river bed.
4. It is however felt that, the W.L. curves of specific discharges made out of the available rating would have revealed these changes in a better way.
5. Fig.465 shows a composite stage-discharge relation at Bahadurabad based on measurements from 1956 to 1962. The plotted points have the appearance of a scatter band. If the portion of the rating curve above 57.00 ft. P.W.D. is considered, it will be seen that the discharge computed from this average rating curve for an individual year may vary as much as 20%. As such, use of a composite rating curve for the purpose of computing discharges, for the years having no measurements should not be done. Moreover it is quite well known that the peak levels, with the passage of a flood wave, the rating assumes the appearance of loop rating. This is possibly due to gradual siltation, or, erosion of the river bed that behave in an unknown and unpredictable way. As such we would rather prefer using the available period of record.



For preparing flood frequency curve, Thomas' plotting position has been used. Neither the formula nor, the advantages of this plotting position over the other commonly used plotting positions in our country (such as, California, Hazen, Weibul or Gumbel.) has been stated. Log-normal probability paper has been used for plotting flood frequency. The logarithmic scale of discharge has suppressed the scatter vary seriously possibly giving deceptive linear, appearance of plot points. A few other distribution could have been tried. Even if log-normal distribution is decided to be used, the floods of different return periods could have been calculated analytically to avoid any personal bias.

It has been assumed that the diversion discharges to the Old Brahmaputra River will be controlled at 30,000 cusecs by an expected barrage on the Old Brahmaputra.

Supposing that the Jamuna Bridge is built at Bahadurabad and the barrage on Old Brahmaputra is not built, under this circumstances while the W.L. down stream the bridge will be lower than the predicated W.L. the diversion flow through the Old Brahmaputra is expected to be more than what it would have been without the bridge, the amount of increase diversion flow being dependent upon the afflux created at the high stage.

This may have the following undesirable effect.

- (i) Increased diversion flow to Old Brahmaputra may create additional flood problem in Mymensingh area.
- (ii) The Old Brahmaputra being the original course of the Brahmaputra might try to swing back to the older course creating major problems.

For that matter, the same problem may arise if the Bridge is located just downstream of Dhaleswari so the back water effect substream of the bridge should be studied in relation to the increased diversion.

#### Chapter V. Co-eff. of roughness.

The Japanese expect stook four measurements at the four proposed sites, Nagarbari, Sirajganj, Gabargaon and Bahadurabad. The number of verticals at which velocity measurements were taken and their distribution across the cross-section does not conform to the standards adopted by the Hydrology Organization of the BWD Board. One major criterion for selecting verticals

is that discharge passing through any of the segments should not be more than 10% of the total flows. Measurements made by the Japanese experts does not conform to this standard.

Value of co-eff. of roughness arrived at is however seems to be alright expect that this value is likely to decrease at high stage. A value of 0.017 seems to be reasonable at peak stage. But a value of  $n = .020$  has been used with a 100-year flood. However this is on the safer side.

#### Chapter VII Design High Water Level

In the report, for calculating Design H.W.L. the 100-year flood of Jamuna was calculated. Diversion flow to Old Brahmaputra was limited by 30,000 cusecs and diversion flow to Dhaleswari was calculated on the basis of a correlation assumed to flow through the average cross-section with  $n = 0.02$ . The D.H.W.L. as calculated on this basis for the four proposed stations as given below:

<u>Sl. No.</u>	<u>Names of station</u>	<u>D.H.W.L. m. P.W.D.</u>	<u>D.H.W.L. ft. P.W.D.</u>
1.	Nagarbari	13.60	44.47
2.	Sirajganj	14.40	47.09
3.	Gabargaon	18.95	61.97
4.	Bahadurabad	20.30	66.38

It may be mentioned here that the recorded highest water level at Sirajganj is 46.64 and at Bahadurabad 66.25 i.e. the 100-year W.L. at Sirajganj and Bahadurabad are 0.45 ft. and .13 ft. above recorded water level. This result does not seem to be convinving enough. A rough calculation shows that H.W.L. of 100-year return period at Bahadurabad on the basis of Annual H.W.L. is 67.40 ft. P.W.D. Again if the entire flow past the Bahadurabad station is confined within embankment on both bank, it is natural that the H.W.L. will increase further.

It may be mentioned here that WAPDA MASTER PLAN SUPPLEMENT 'E' special studies prepared by I.E. CO. on the basis of data upto 1962 shows that for an assumed flow of 2,980,000 cusecs at Bahadurabad and a simultaneous flow of 2,650,000 at Hardinge Bridge the W.L. at Bahadurabad will be as follows.

- |                        |                   |
|------------------------|-------------------|
| (i) Without Embankment | -67.50 ft. P.W.D. |
| (ii) With Embankment   | -69.50            |

To us it seems that a Design H.W.L. of 69.50 ft. at Bahadurabad will be more reasonable than proposed 66.38 ft. P.W.D.

#### Chapter VI Minimum Width

The Gabargaon section of the Jamuna River has maintained a very stable section. From the records from 1964 to 1972, the width of the river has varied from 4.3 km. to 5.1 km. Calculation of min. river width for river spanning by a method based on the behaviour of river characteristic seems to be better than the other empirical methods.

