

## **C. BRIDGE**

## C.1 Extractions of Collected Data for Structures, and Records of Meeting/Hearing

### (1) Collected Data for Structures

**Table C-1 Collected Data**

<b>1. Mongolian Standards</b>	
Highway Design Standards	Republic of Mongolia, 1998
Highway Construction Specifications	Republic of Mongolia, 1998
Construction Norms and Regulations Road Bridges and Pipe Culverts, BNbD 2.05.03 – 97	Road Department, Government Agency, Ulaanbaatar- 1997
City Construction, Planning and building of Urban and Rural Settlements, SniP 2.07. –89	Ulaanbaatar City, 1989
<b>2. Topographic Maps</b>	
Erdene to Undurkhaan Scale 1:25,000 1:100,000, 1:500,000	
<b>3. Drawings</b>	
Detailed Design Drawings of Bridges between Erdene, Baganuur and Undurkhaan (14 Bridges)	Road Department, Government of Mongolia 1992, 1998, 1999
As-built Drawings of Kherlen Bridge for Reinforcement for Pier and Girder	Monaz Co.,Ltd. Road Department, Government of Mongolia, 1993
Standard Drawings of RC T-Girder (Girder Length 12, 15, 18m)	Road Department, Government of Mongolia
<b>4. Reports</b>	
Construction Norms and Regulations, SniP II -7-81 M-87, Design Norms, Construction in Seismic Regions	State Construction Committee of Government of Mongolia, Dec.17, 1987
Review of Road Design and Construction Standard	Asian Development Bank, 1993
Feasibility Study Report for Erdene-Bulgan-Moron Road Project (Kuwait Fund TA No.186)	Government of Mongolia, Ministry of Infrastructure, Department of Roads, Feb. 2001
Road Master Plan & Feasibility Study (T.A No. 1820-MON) Intercontinental Consultants & Technocrats PVT LTD	Asian Development Bank Technical Assistance, Mongolia
Construction of Darhan-Erdenet Road from 0km - 184km (Kuwait Fund)	Department of Roads, Ministry of Infrastructure Development, Government of Mongolia

### (2) Extractions of Mongolian Specifications

#### 1) Materials

##### **RUSSUAN STANDARD FOR ROAD BRIDGE AND PIPES SniP 2.05.03-97**

##### **\* Materials for Concrete and Reinforced Concrete Structures**

- Concrete General Description 3.18 to 3.36
- Average density of heavy concrete: 2.2-2.5t/m<sup>3</sup>

Class of compressive strength: B20-B60

Reinforced concrete, applying not less than B20, B22.5

(Axle pressure strength of prism  $R_s$  B20-105kg/cm<sup>2</sup>, B22.5- 120kg/cm<sup>2</sup>)

(Axle pressure strength of prism  $R_{\sigma, \delta}$  er B20- 155kg/cm<sup>2</sup>, B22.5- 170kg/cm<sup>2</sup>)

- Reinforcement 3.33 to 3.36

Class of reinforcing steel bar: applying A- II for main members

A- I (Hot rolled with smooth surface- dia.6-10mm)

A- II (Hot rolled with rib surface- dia.10- 32mm)

- Reference: Darhan Metallurgical Plant- Information on Manufacturing Product

Steel Grade (deformed Bar)	Length (Dia mm)	Chemical Composition %					Strength(N/mm <sup>2</sup> )	
		C	Si	Mn	P	S	Yield	Tensile
SD295	6000-	0.16-0.18	0.15-0.37	0.60-0.90	0.04 max	0.04 max	295 min	440-600
SD345	12000mm	0.18-0.20	0.15-0.37	0.80-1.00	0.04 max	0.04 max	345-440	490 min
SD390	(10- 32)	0.18-0.26	0.15-0.37	0.95-1.25	0.04 max	0.04 max	390-510	560 min

- Reference: Asian Development Bank, Material Strength

Concrete compressive strength,  $f_c' = 24$  Mpa (245 kgf/cm<sup>2</sup>)

Reinforcing steel yield strength,  $f_y = 414$  Mpa, Grade 60,  
(42.2kg/mm<sup>2</sup>)

## 2) Earthquake

**CONSTRUCTION NORMS AND REGULATIONS, DESIGN NORMS, SniP II-7-81,M-87**

Seismic Regions and Value (Class or Range in Mongolia : 1 to 12)

Ulaanbaatar City: 6, 7, 8

Undurkhaan: 6, Baganuur: 6, Erdene: 7

- Reference: Seismic Coefficient

Horizontal force to structural calculation  $K_h=0.10$  min.

### 3) Live Loading System (Mongolian Standard)

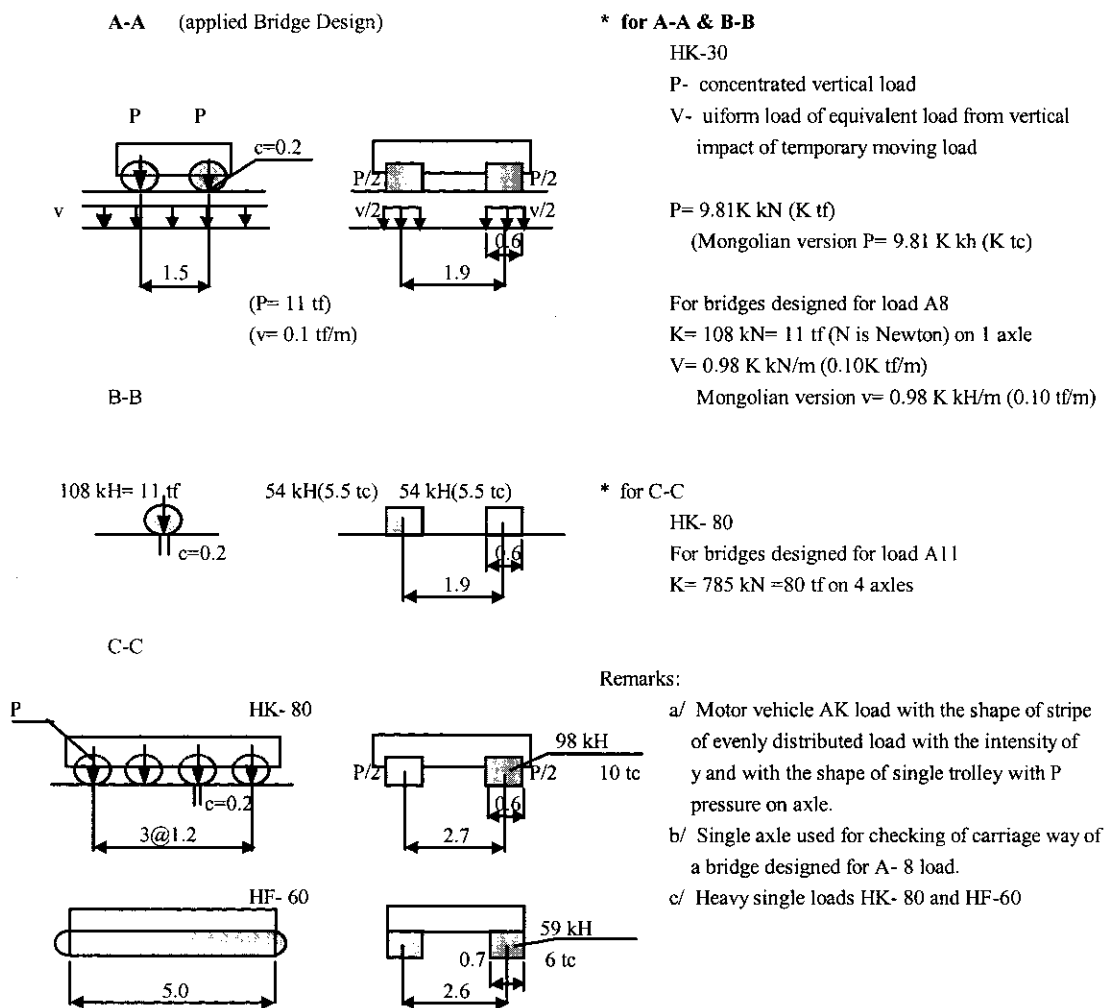
#### RUSSIAN STANDARD FOR ROAD BRIDGES AND PIPES

SNiP 2.05.03-97

(Extracts)

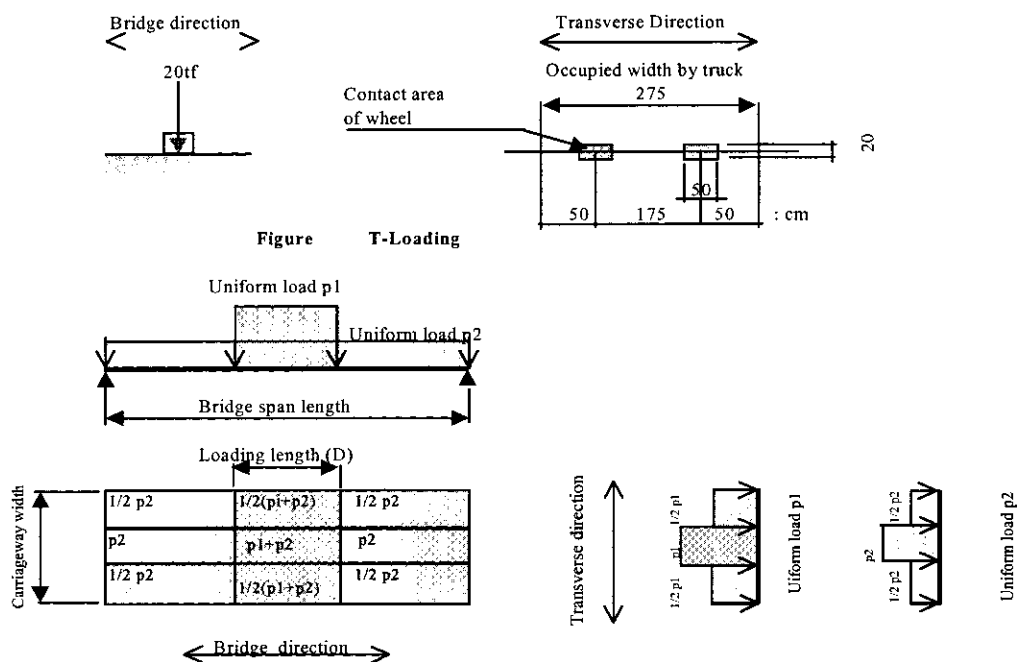
2.19 Normative ice load coming from the ice pressure on bridge piers should be taken in the form of fore calculated in accordance with the obligatory Attachment 6.

Figure 1. Scheme of loads coming from the rolling stock and used in calculation of road and city bridges.



- Reference Japan Loading System

A, B Live Loading [Japan Road Association, 1994]



**Table L- Loading ( B-Live Load, Japan )**

Main loads ( width 5.5m )						(L: Span)
Uniform loads p1			Uniform loads p2			Sub loads (width-5.5m )
Loding length D (m)	Load (kgf/m2)		Load (kgf/m2)			
	for Bending Moment	for Shearing Force	L<80	80<L<130	L>130	
	10	1.000	1.200	350	430-L	300
						50% of Main load

**Table Uniform Loading for Sidewalk**

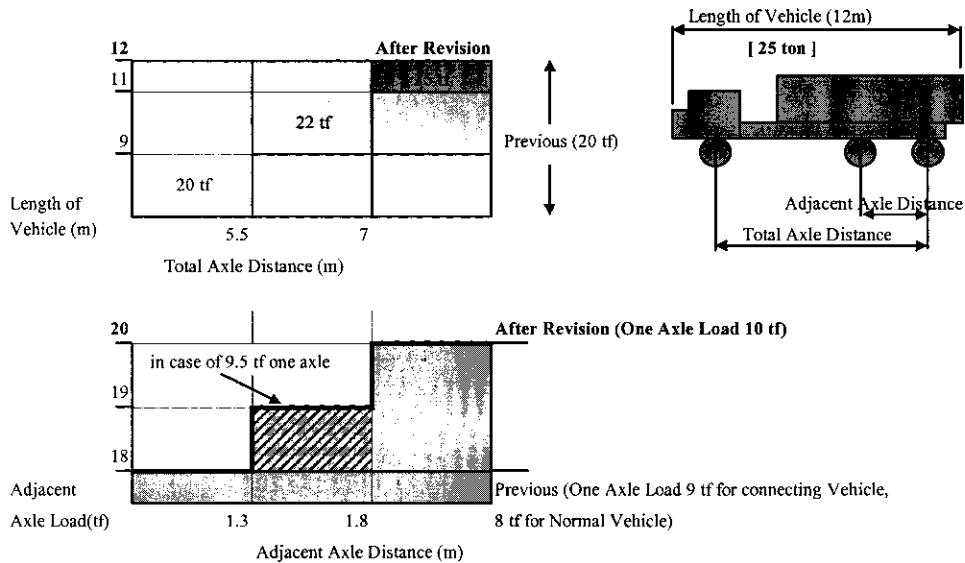
	For Slab	For Main Girder		
Span Length (m)	-	$L \leq 80$	$80 < L \leq 130$	$130 < L$
Uniform Load (kgf/m <sup>2</sup> )	500	350	430-L	300

## Revision of Live Loading (A, B) System in Japan, 1994

For the purpose of affecting the physical distribution of international transportation, the new live loading system (heavy vehicle) was established to apply for Japanese Highway and Specified Road in year 1994.

### 1. Revision the total weight of vehicle for transportation [ Except Trailers ]

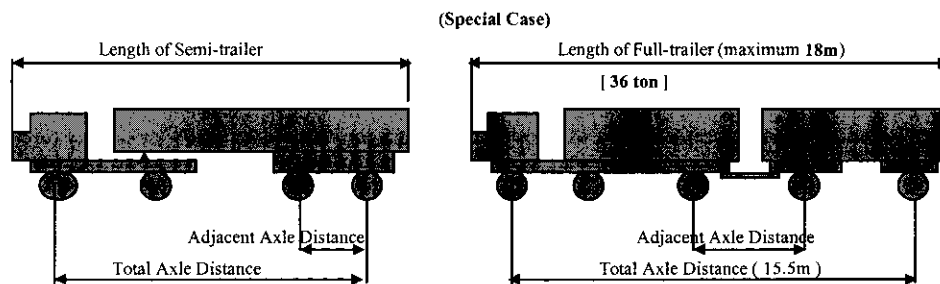
The maximum total weight of one vehicle shall be defined 25 ton according to length and axle distance on the highway transportation.



### 2. Expansion of total weight of vehicle as special case [ For Trailers ]

The maximum total weight of semi-trailer and full-trailer shall be defined 36 ton according to length and axle distance on the highway transportation.

\* Type of Trailer- All kinds of trailer (Van, Container, Tank, Convertible(roof), Carry of car)

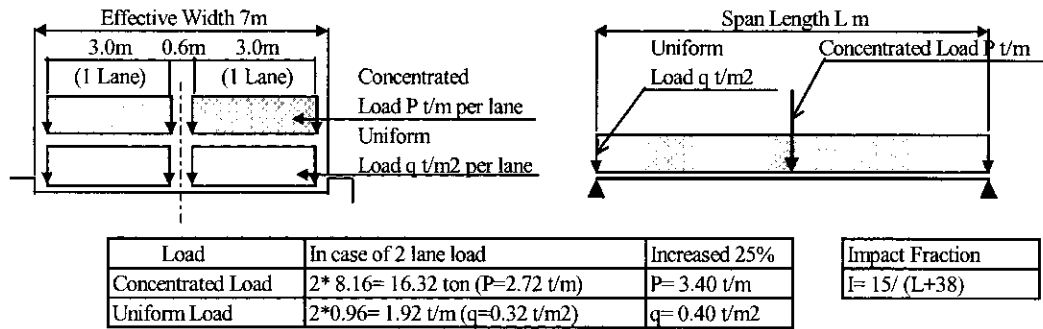


3. Based on the above items 1, 2, and conditions of continuous traffic flow of 25 ton vehicles, the liveloading system was defined the two kinds of scale (A and B Loads), considering heavy/large traffic with high frequency.

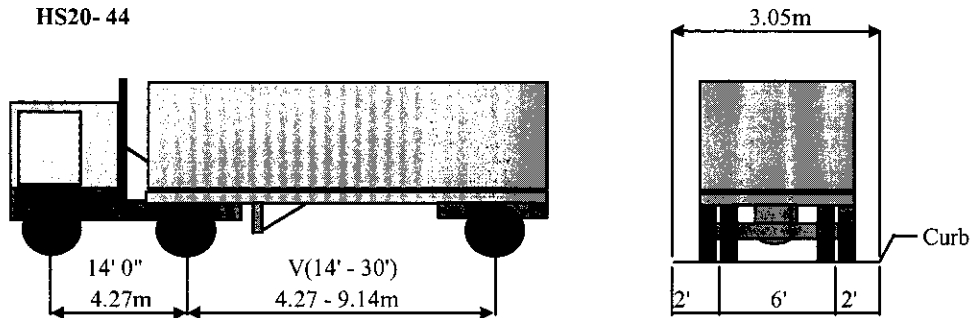
- American AASHTO Standard

Standard Specifications for Highway Bridges, 1995

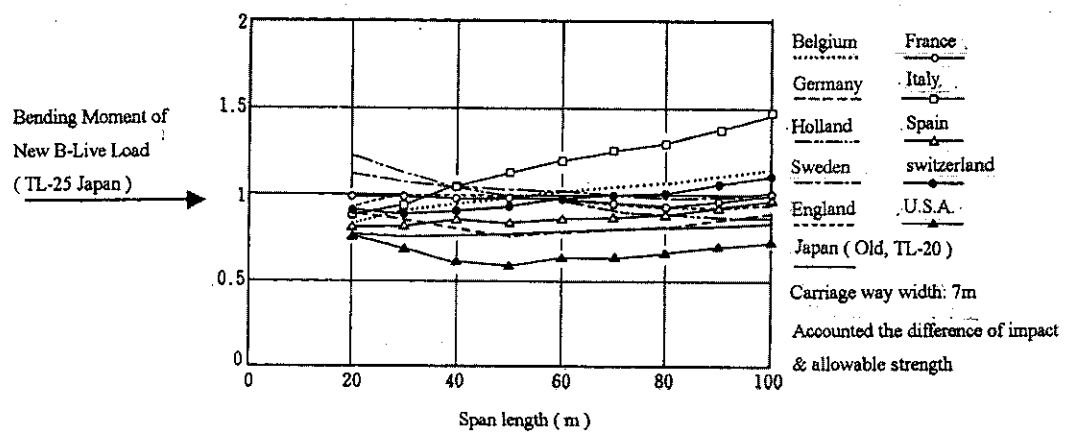
ASSHTO American Standard HS20-44



HS20-44



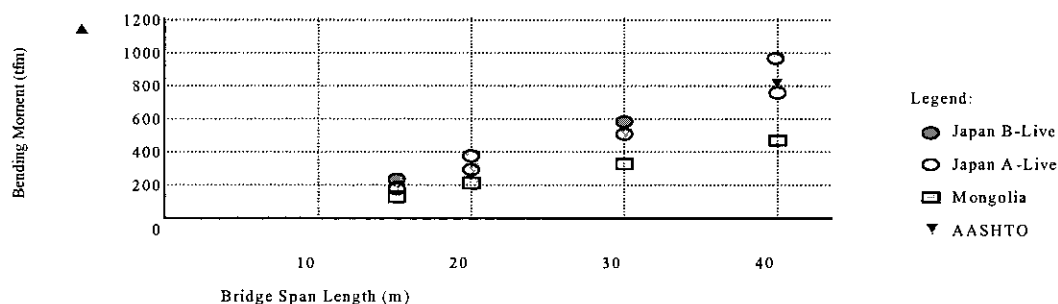
- Live Load System (Bending Moment) in the World



- Comparison Table for the Bending Moment between Mongolian, Japanese and AASHTO

Comparison of Bending Moment (Carriageway width = 7m)

Bridge Span Length (m)	15	20	30	40
Mongolian (tfm)	154.13	213.50	336.00	463.50
Japanese B-Live (tfm)	217.79	343.78	636.78	984.48
Japanese A-Live (tfm)	174.04	268.78	499.28	784.48
AASHTO (tfm)	184.75	279.41	516.31	815.54



### (3) Records for Meeting

#### Meeting No.1

Date: April 9, 2001

Attendance:

##### Counterpart

Mr. Garav Bat Togtokh, Leader of Counterpart

##### Study Team

Mr. Takai, Mr. Takeuchi, Mr. Kaneko, Mr. Hara, Mr. Tanaka

##### Interpreter

Mr. Baatar Sukh

Subject: Request of Data collection

The study Team requested to Mr. Garav Bat Togtokh the data collection as Questionnaire in Inception Report, as mainly road/bridge. The request of data collection for environment, development plan, and traffic demand will be informed in next week.

#### Meeting No.2

Date: April. 10, 2001

Attendance:

##### Counterpart

Mr. Tsedenpil, Bridge section of Counterpart

##### Study Team



Mr. Takai

Interpreter

Mr. Baatar Sukh

Subject: Data collection for bridge section and schedule of inventory

The Study Team requested to Mr. Tsedenpil the data collection of bridge section, and informed the schedule and the contents of bridge/culvert for field survey.

### Meeting No.3

Date: Apr.16, 2001

Attendance:

Counterpart

Mr. Garav Baat Togtokh

Study Team

Mr. Takai

Subject: The Detailed Design Drawings in the Project Road, by Road Department

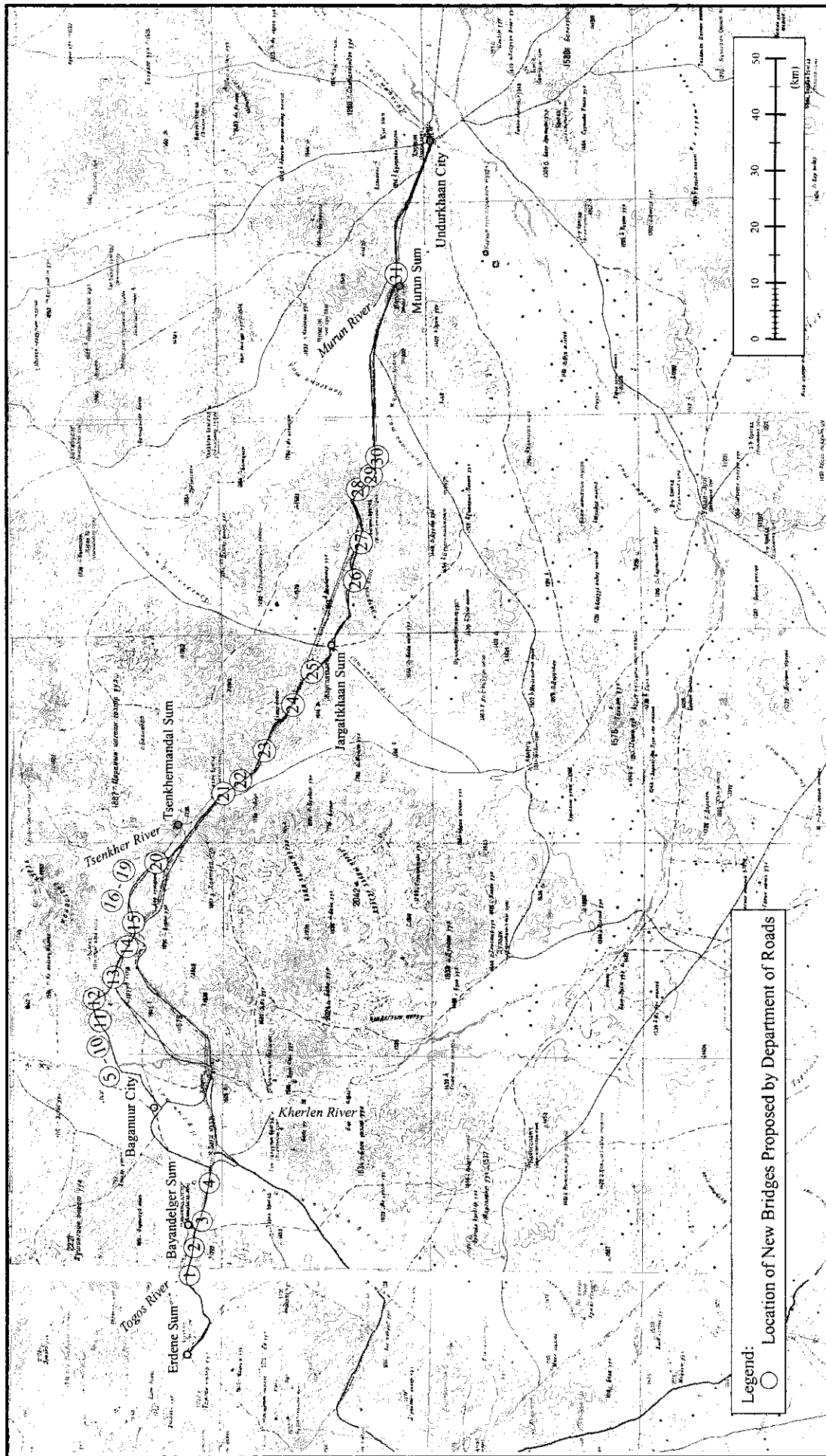
The Study Team asked Mr. Garav Bat Togtokh the locations and the number of bridges which were designed by Road Department and numbers.

Mr. Garav Bat Togtokh informed the Study Team the locations and the number of bridges as following list and location map.

**Table C-2 Detailed Design for Bridges between Erdene and Undurkhan**

By Road Department, Ministry of Infrastructure

No.	Type	Length	Span	Station	Remarks	Location
1	RC-T	75.7	5@15.0	617 + 34.6	Togos	Togos River
2	RC-reU	9.0	8.73	642 + 46.0	Tal Bulag	↓
3	RC-reU	9.0	8.73	678 + 30.5	Delger	↓
4	RC-reU	9.0	8.73	745 + 55.5	Rashaant	Baganuur
5	RC-T	343.5	19@18.0	35 + 67.75	Kh main	Kherlen River
6	RC-T	36.7	3@12.0	44 + 3.0	Kherlen Trib	↓
7	RC-T	24.0	2@12.0	48 + 78.0	Kherlen Trib	↓
8	RC-T	24.0	3@18.0	69 + 6.0	Kherlen Trib	↓
9	RC-T	55.0	3@18.0	71 + 2.0	Kherlen Trib	↓
10	RC-T	91.0	5@18.0	73 + 70.0	Kherlen Trib	↓
11	RC-reU	6.5	6.0	132 + 54.0		↓
12	RC-reU	6.5	6.0	151 + 28.0		↓
13	RC-Slab	9.6	9.0	216 + 57.0		↓
14	RC-Slab	9.6	9.0	278 + 12.0		↓
15	RC-T	12.5	12.0	311 + 77.5		↓
16	RC-reU	6.5	6.0	322 + 80.0		↓
17	RC-Slab	9.6	9.0	330 + 35.0		↓
18	RC-reU	6.5	6.0	344 + 88.0		↓
19	RC-reU	6.5	6.0	349 + 9.0		↓
20	RC-Slab	9.6	9.0	446 + 82.0		↓
21	RC-T	54.1	3@18.0	6 + 6.0	Tsenkher	Tsenkher River
22	RC-T	15.0	15.0	26 + 60.5	Urugun Valley	↓
23	RC-Slab	6.0	6.0	100 + 97.0	Ar Khadagtai Valley	↓
24	RC-Slab	6.0	6.0	122 + 77.0	Zuulun Valley	↓
25	RC-T	15.1	15.0	275 + 29.79	Urt Valley	Jargartkhaan
26	RC-Slab	6.0	6.0	453 + 42.0	Ulaan Khudag Valley	↓
27	RC-Slab	6.0	6.0	537 + 97.0	Gichgeny Valley	↓
28	RC-T	18.1	18.0	193 + 25.0	Duut	↓
29	RC-Slab	5.0	5.0	175 + 0.0		↓
30	RC-Slab	5.0	5.0	141 + 26.0		↓
31	RC-Slab	36.3	4@9.0	1 + 60.1	Murun	Murun
Total Length		932.9m				Undurkhaan



**Figure C-1**      **Location Map of New Bridges Proposed by Road Department**

Meeting No.4

Date: May 18, 2001

Attendance:

Mongolian

Refer to the List of Participants

Study team

Mr. Maruoka, Mr. Takai, Mr. Nakano

Interpreter

Mr. Baatar Sukh

References:

Requested letter

Appendices for bridges

1. Comparison of Girder section between Mongolian and Japanese Standards
2. General view of Proposed Bridge
3. Existing Bridge in Mongolia (photographs)

Subject: Proposal for the Type of Bridges to be applied for this Project

The Study Team requested to have a technical committee for the bridge standard on the 4th of May, 2001.

Road Department of the Ministry of Infrastructure set the meeting. The attendance was almost Mongolian Bridge Engineers.

Mr. Maruoka (JICA Team Leader) explained the background of the study as follows;

- Study Team found out that road including bridges between Erdene – Baganuur were commenced construction.
- Millennium road is to be designed/constructed based on the International Standard.
- Mr. Takai (Bridge Engineer of Study Team) studied Mongolian bridges in recent four years.
- Not a few problems were found in the structure of the bridges.

Question & Answer (Mongolian to the Study Team)

- 1) Who will construct the bridges for the Project? What will be the technical transfer? Is the Mongolian situation considered to intend the proposal?
  - As of present Study, the Project road will be constructed by Mongolian side.
  - The proposed RC T girder type is simply/easily constructed in Mongolia, and materials are available domestically.
  - At the erection of the girder, girder launch method is required due to heavy

weight. This will be a technical transfer.

- The Study Team said that the millennium road should be designed and constructed based on International Standard.
- 2) What is the reason of the proposed RC T- section of girder (larger width), without PC girder?
- The existing Mongolian Standard section of RC T-girders (length 12,15,18m) is insufficient strength for the heavier live loads, lack of rigidity due to no- cross beam, difficulty of casting concrete because of shortage of covers between re-bars, and no-vertical setting the girders.
  - Study Team explained that the proposed RC T- section of girder has designed in accordance with heavier live loading method as Japanese Standard.
  - Study Team selected the easiest shape of T- section to avoid the above problems.
  - The type of PC girder is difficult for construction in Mongolia, because the PC materials and jack, etc shall be imported, and to be required the control of tensioning and high concrete strength.
  - The T- girder of Japanese Standard is also modified to simplify in several years ago.
- 3) What does the plan of Study Team for existing bridge on Kherlen River, and other bridges of millennium road?
- Study Team is studying the selection of appropriate route at present. Depending on the selected route, the scale and type for the bridges including Kherlen River bridge shall be determined.
  - Study Team suggests that every bridge on the route should be constructed based on International Standard. It is, however, out of our Study Area.
  - Study Team is investigating the present condition of Kherlen Bridge, there are many cracks on the girders and elevation on the bridge surface is uneven, constructed in year 1974.
- 4) What is the reason the proposed type of T- girder section?
- It is the points of view from the economical cost and easier construction aspects.
- 5) What is the International Standard?
- It is the live load and other conditions which are applied in designing/ constructing Asian Highway, by ADB, Japanese Grant Aid, Kuwait Fund, etc.
- 6) What is the critical item of this meeting between Mongolian committee and Study Team?
- To standardize the type and construction for the bridge
  - To postpone the construction, and re-design with new standard for the Togos River bridge.

- 7) Is the Study Team saying that the Mongolian (Russian) bridge standard or construction conditions are not appropriate? If it is mentioned above, it will be required a certain amount of cost to repair or reconstruct the existing bridges. What is the opinion of the study team?
- The girders have defects/damages.
  - The girder does not have sufficient strengths according to American AASHTO or Japanese Standard.
  - The Study Team will be finalized the F/S Study in March 2002, and will be suggested the criteria of the bridges as quickly as possible.
  - To reinforcement of the bridge is difficult because of difference of concrete age and long period, and the cost will be very high.
  - (M) Mongolian Standard is under revising to wide the girder width, and to thick the slab by professional Engineers.
  - (M) The Togos River bridge is not mentioned in the request letter. Mongolian DOR(Department of Road) is not ready to discuss the matters today.

### Summary

Deputy Director:

Mongolian DOR basically accepted the proposal of the Study Team, and will support the Study Team. Mongolian DOR would like to define the standard for the bridge as soon as possible for the construction of millennium road. Mongolian DOR would like to standardize to be low cost to maintain as well as to construct, and also with less material. Mongolian DOR would discuss for the Togos River bridge on another day.

### List of Participants (Mongolian Side)

May 18, 2001

No.	Name	Position
1	B.Enkhtur	Deputy Director, DOR
2	B.Erkhembayar	Bridge Consulting Engineer
3	E.Oyunchimeg	Project Manager
4	D.Nasanjargal	Consulting Engineer
5	T.Baasan	Director of "Sergelt-Auto Zam" company
6	L.Aviya	Engineer of "Sergelt-Auto Zam" company
7	Z.Tsedenpil	Consulting Engineer
8	D.Ulziidelger	Road Engineer
9	N.Adilbish	Head of division DOR
10	B.Purevbaatar	Bridge Engineer "Steel Bridge" Co., Ltd.
11	D.Bazargur	Bridge Engineer "Steel Bridge" Co., Ltd.
12	G.Battogtokh	Leader of counterpart team
13	Ch.Bayasgalan	Counterpart for Bridge

Meeting No.5

Date: July 31, 2001

Attendance:

Technical Committee of DOR including Bridge Advisors

Study Team:

Mr. Maruoka, Mr. Takai , Mr. Takeuchi

Interpreter:

Mr.Baatarsukh, Mrs.Bolormaa

Reference:

Extractions of Progress Report for F/S

Sheets of Selection for Route Crossing Kherlen River

Conditions of Existing Bridge and Outline of Southern Route

Subject:

Selection of Route crossing Kherlen River

Mr.Maruoka explained to the Technical Committee the outline of this Progress Report.

Summary of Discussion for Utilization of Kherlen Bridge at Southern Route :

- (M): The Committee member said that the existing bridge could be utilized with repairs or reinforcement.
- (T): The Study Team replied that reinforcement of the bridge (super/sub-structures) shall be studied conforming to International Standard. These studies will be conducted with comparison table at next stage. And Technical Committee and Study Team will discuss again at an early time.
- (M): The Committee member asked where is planned the new bridge of Southern route.
- (T): The Study Team replied that location of new bridge is planned 1 km down-stream side from existing bridge.
- (M): Mr.B.Enkhtur, Deputy Director, DOR finalized as follows:
  - Technical Committee's opinion expected to utilize the existing bridge for limited Mongolian construction finance.
  - Technical Committee agreed "Southern Route" crossing Kherlen River at present.

Meeting No.6

Date: August 7, 2001

Attendance:

Steering Committee of Infrastructure, Mongolian Government

Study Team:

Mr. Maruoka, Mr. Takeuchi, Mr. Takai, Mr. Tanaka

Interpreter:

Mr. Baatarsukh, Mrs. Bolormaa

Reference:

Progress Report for F/S

Subject: Explanation for Progress Report, with OHP film

Summary of Discussion for Bridge Section

(M): The progress report was made based on the discussion of previous technical committee. Therefore, South route located near existing Kherlen bridge is appropriate, comparing North and Middle routes. The Committee agreed South route.

However, the load capacity (limitation) of the existing kherlen bridge shall be calculated, and to be informed the Committee at an early time.

The committee will be expected to re-utilize the existing bridge with improvement, because of Mongolian property.

The selection of bridge type including steel bridge shall be reported at next technical committee.

(T): The Study Team replied that the most appropriate location of South route crossing the Kherlen river will be determined by reason of the possibility of utilization for existing bridge. Therefore, Study Team will be studied/discussed the method of utilization for existing bridge in next technical committee and interim report together with standard type and design criteria of bridge.

And, design criteria and standardized type for the Project will also be studied/discussed in next technical committee and interim report.

Meeting No.7

Date: September 20, 2001

Attendance:

Mongolian:

Refer to the List of Participants

Study team:

Mr. Takai, Mr. Nakano

Interpreter:

Mr. Ts. BaatarSukh

References:



Request letter

Attachment for Technical Committee (Bridge Section)

1. Consideration of Existing Kherlen Bridge
2. Discussion / confirmation of Standardized RC-T Girder & Design Criteria
3. Design Criteria for Bridge

Subject: Consideration of Kherlen Bridge & Design Criteria for Bridges

The Study Team requested to have a technical committee for the bridge on the 19th of Sep 2001.

Department of Roads of the Ministry of Infrastructure set the meeting.

Mr. Takai (Bridge Engineer, JICA Study Team) explained the handout. The contents were as follows;

- The Study Team had compared 3 main alternative cases of Kherlen Bridge.
- PC-T/Box girder type is recommended concerning the comparison.
- The existing bridge is recommended to repair and utilize by limiting the maximum live load up to 14 tons.
- Standard girder should be RC-T girder, as it is agreed in previous technical committee meeting held on 18 May, 2001. The study team requested to confirm the Design Criteria for bridges.

Question & Answer (Mongolian to the Study Team)

- 1) What is the reason to demolish the existing Kherlen Bridge when new bridge has been constructed? The cost of demolition seems to be a waste. New bridge should be 9.0m wide.
  - It is not practical to construct 9.0m wide bridge and leave the existing one as road bridge. There is not sufficient traffic for it. The other purpose should be found to leave the existing bridge. The study team will add it as a alternative with new purpose of existing bridge.
- 2) Is there any possibility to build a steel girder bridge? If so, the span of it could reach up to 60.0m and the cost could be reduced
  - The study team will add the steel girder as a new alternative to the comparison. The cost would not be reduced so much considering the past record of Japanese construction.
- 3) Is there any possibility to construct I-girder? What would the cost be?
  - The cost would be fairly same with T-girder.
  - There will be casting work of concrete slab on site. The forming work will be very complicated. Therefore, it would be difficult to control the quality of girders.
  - Construction period will be longer as well.
- 4) How about reducing the width of alternative C2 to 8.0m?

- It could be added to the comparison. The study team will continue to examine it.
- 5) The width is not enough in the alternative C3. It will be enough for two lanes of Mongolian standard if it will be widen to 6.5m (carriage way).
  - It will be widen to 6.5m (carriage way). The total width will be 7.5m.
- 6) Is it possible to build 30m long PC-T girder? If so, it could be highly recommended alternative for Mongolia for the technology transfer.
  - It is possible to build 30m PC-T girder.
  - The study team has already studied 25.0m PC-T girder. It will be added to study 30.0m RC-T girder.
- 7) The existing bridge could be utilized as a bridge for the livestock to cross the river. There would be no need for repair nor demolition.
  - It could be good idea to study. Also, it can utilize for limited vehicles.
- 8) As the route is on the Millennium Road, width of the bridge should be more than 6.5m (carriage way).
  - The study team will change alternative C3 to 6.5m (carriage way) wide.
- 9) The repairing cost of alternative C3 seems to need more cost. It is requested to be high qualified so that the existing bridge could last at least for 30 years more.
  - The study team will review the cost of repair.

### **Summary**

Deputy Director:

It is agreed that the crossing point will be next to exiting bridge on downstream side for new Kherlen River Bridge. There remain two issues to be kept on studying. First is the width of carriage way and the other is the type of girder. New bridge needs to have at least 6.5m of width. The following items are required to be considered to set the girder type of bridge:

- (1) technology transfer to Mongolia
- (2) new technology for Mongolia
- (3) long span bridge
- (4) low construction cost. The committee also request for the study team to study the foundation type for the new bridge.

### List of Participants

20 September 2001

No.	Name	Position
1	B. Enkhtur	Deputy Director, DOR, Technical Committee Chairman
2	I. Gonchigzeveg	Head of Construction of Management & Supervision Division, DOR
3	L. Gombo	Head of Planning & Research Division, DOR
4	N. Adilbish	Head of Maintenance Management division DOR
5	T. Baasan	Director of "Sergelt-Auto Zam" State owned Company, Bridge Constructing Engineer
6	Z. Tsedenpil	Bridge Consulting Engineer, "Mon-AZ" Company
7	T. Batjargal	Director of "Mon-AZ" Company
8	T. Byanbaa	Road Engineer, Project implementation Unit, DOR
9	H. Gantumur	Bridge Engineer, Project Implementation Unit, DOR
10	D. Baasankhuu	Project Manager, Second Roads Project , World Bank
11	G. Battogtokh	Leader of counterpart team
12	Ch. Bayasgalan	Counterpart for Bridge Planning

Minutes of meeting No.8

Date: 3 December 2001

Place: Room 414, DOR forth floor

Attendance: Mongolian Refer to the List of Participants

Study team Mr. Takai, Mr. Nakano

Interpreter Mr. Ts. Baatarsukh

References: Handout of presentation (Interim Report)

Subject: 1. Design Criteria

2. Consideration of Existing Kherlen Bridge

3. Standardized RC-T Girder Bridges and Box Culverts

The Study Team informed the contents of Interim Report to the main member of Department of Roads (DOR) before the Steering Committee on the 3<sup>rd</sup> of Dec. 2001.

Mr. Takai (Bridge Engineer, JICA Study Team) explained the handout. The contents were as follows;

- The Study Team had studied and recommends PC-T girder type with 6.5m carriage way for the Kherlen Bridge.
- The existing bridge is recommended to repair and utilize by limiting the maximum live

load up to 14 tons.

- Standard girder should be RC-T girder.
- The study team suggested and planned 8 bridges and 32 box culverts for implementation plan.

#### Question & Answer (Mongolian to the Study Team)

1) Mongolian side wishes to build the Kherlen River Bridge with 9m width. Is there any possibility to widen the carriage way width to 8m?

- There is not so much possibility if we consider the discussion in technical committee and the construction cost. Also it is not practical to construct 9.0m wide bridge and leave the existing one as road bridge. There is not sufficient traffic for it.

2) Is there any possibility to build a steel girder bridge? If so, the span of it could reach up to 60.0m and the cost could be reduced

- The study team will add the steel girder as a new alternative to the comparison. The cost would not be reduced so much considering the past record of Japanese construction.

3) Isn't it better to cross the Kherlen River at more northwards, if the alternative A-2 is selected for Baganuur area?

- The river is very much wider and the flow channel is not fixed at north part of existing bridge. New bridge will be much longer and the cost of both construction and maintenance will increase considerably. Considering the loss of the distance, it is appropriate to set the river crossing point at the existing point.

4) Is the river training included in the implementation plan? If it is, how is the scale of it?

- We have considered the river training for each bridge. It will be sufficient for each river.
- Existing revetment will be utilized at the Kherlen River.

#### Summary

Director:

It is better to construct box culvert instead of pipe culvert to make the embankment lower, for the cover will be thinner over the culvert. It also can reduce both construction and maintenance cost.

I have mainly understood of bridge standard, design criteria and implementation Plan.

## List of Participants

3 December 2001

No.	Name	Position	Organization, Division
1	Mr. Bud	Director	DOR
2	Mr. Gombo	Head	DOR, Planning and Research Division
3	Mr. Gonchigzeveg	Head	DOR, Construction Management and Supervision Div.
4	Mr. Luvsan	Officer	DOR, Maintenance Management Division
5	Mr. Adilbish	Head	DOR, Maintenance Management Division
6	Mr. Byamba	Officer	DOR, Construction Management Division
7	Ms. Gerelnyan	Officer	DOR, Planning and Research Division
8	Mr. Battogtokh	Leader	DOR, Counter Part
9	Ms. Oyunchimeg	Project Manager	DOR, ADB Second Phase
10	Mr. Erhembayar	Director	GBET Company
11	Mr. Bayasgalan	Bridge Engineer Officer	DOR, Counter Part, Construction Management and Supervision Div.

Minutes of meeting No.9

Date: 4 December 2001

Place: Conference Room (3F) in Ministry of Infrastructure

Attendance: Refer to the List of Participants

Subject: 1. Design Criteria

2. Consideration of Existing Kherlen Bridge

3. Standardized RC-T Girder Bridges and Box Culverts

The Study Team informed the contents of Interim Report to the Steering Committee on the 4<sup>th</sup> of Dec. 2001.

Mr. Maruoka (Team leader, JICA Study Team) explained the summary of the Interim Report.

The contents were as follows;

- The Study Team had studied and recommends PC-Box girder type with 6.5m carriage way for the Kherlen Bridge.
- The existing bridge is recommended to repair and utilize by limiting the maximum live load up to 14 tons.
- Standard girder should be RC-T girder.
- The study team suggested and planned 8 bridges and 32 box culverts for implementation plan.

Question & Answer (Mongolian to the Study Team)

1) Dr. Sereeter:

The Kherlen River Bridge should be constructed with 8m of width and sufficient length of 100 year return period. This bridge is better than the proposal of the study team. The idea of limiting the load with repair on exiting bridge is not sufficient.

- Mr. Maruoka:

We have discussed about the Kherlen River Bridge with Mongolian Technical Committee for the Bridge several times already. The proposal is the conclusion of the discussion. However, we will make an opportunity to discuss about it later.

The length is set by the economical analysis. The IRR would be less than 12 if the bridge was planned as the final stage, and the pavement was asphalt concrete all the route.

The study team suggests constructing the bridge as the proposal with small amount of cost and completing the construction step by step as the traffic increases.

2) Mr. Bud:

I would like to request to study steel girder bridge for the Kherlen River Bridge.

- Mr. Takai:

We have already studied and compared the girder type with others. Table of comparison is on Page 9-23.

3) Dr. Sereeter:

Would the new bridge be destroyed if the flood occurs in the near future before its completion?

- Mr. Maruoka:

It is probable that the bridge will remain and the embankment will be destroyed. The existing revetment is not sufficient for the flood for 100 years return period and flow channel is not fixed. It is also estimated that flood flow channel covers the whole bridge with low level.

4) Dr. Sereeter:

How is the traffic of the Kherlen Bridge planned? Could you explain in details?

- Mr. Maruoka:

We are planning to use the existing bridge towards Baganuur and new bridge towards Undurkhaan. The two bridges are used as a one way road respectively. The check point is planned at the end of bridge to check the axle load. The heavy vehicles will be passing the new bridge. The traffic volume will be 1000 veh/day.

5) Mr. Bud

Which RC bridge will be replaced in the implementation plan?

- Mr. Maruoka:

The Khujirt River and the Kherlen River.

Summary from Mongolian member of steering committee

- Mr. Bud

I consider new Kherlen Bridge should be more than 8m wide. The implementation of the study team is not sufficient in following reason. The existing bridge has limitation of load and new one is not wide enough for 2 lane.

- Dr. Sereeter

I would like to request the review of the Kherlen Bridge consideration, especially on width of carriage way, total length, crossing point and discharge capacity.

Signed minutes:

Both sides confirmed that the type and location of bridge over Kherlen River will be studied further on condition that the existing bridge will be used effectively. The Mongolian side requested that a new bridge in addition to the existing bridge will be the same width as the standard width of "the Millennium Road Plan", namely, 8m wide.

#### List of Participants

4 December 2001

No	Name	Position/Designation	Department/Organization
1	Mr. Sereeter	Director	MOI, RTIT
2	Mr. Bud	Director	DOR
3	Mr. Gombo	Head	DOR, Planning and Research
4	Mr. Naranpurev	Director	MOI, ICDiv
5	Mr. Chuluun	Officer	MFE, ECMC
6	Ms. Bolormaa	Officer	MOI, RTIT
7	Mr. Battogtokh	Leader	DOR, Counterpart
8	Mr. Oi	Head	Advisory group
9	Mr. Hashimoto	member	Advisory group
10	Mr. Nakane	member	Advisory group
11	Mr. Maruoka	Leader	Study team
12	Mr. Takai	Bridge Engineer	Study team
13	Mr. Hara	Highway Engineer	Study team
14	Mr. Nakano	Coordinator	Study team

#### 4) Hearing Records

1. Existing Kherlen River Bridge (Mr.Magcarjav, Road Department, Apr.18, 2001 in Undurkhaan)

Based on the following reasons, Members of Road Department said that the existing bridge on Kherlen River is less stabilized for transportation. As the results of checked the bridge by Professional Bridge Engineers at 2 years ago, the bridge has insufficient conditions of constructed pier (difference of center between column and foundation) in 1974, even reinforcement with foundation in 1993, and has deteriorated carriage way surface.

2. Construction of Kherlen river bridge (Mr. Badarch, Contractor, Ganguur Company, May 4, 2001)

The Study Team asked that the fifth pier of Kherlen river bridge was missed to set during construction. Mr. Badarch, the contractor said that caisson of pier was suffered damage from flood during excavation. Therefore, the center of pier could not constructed correctly.

3. Earthquake in Mongolia (Mr.Gonchigzeveg, Director, Road Department, May 4. 2001)

In accordance with “Design Norms Construction in Seismic Regions” for earthquake, the class of earthquake in Mongolia is distributed in the range of 1<sup>st</sup> to 12<sup>th</sup>. The class of earthquake in the Project Road between Erdene and Undurkhaan is 6<sup>th</sup> and 7<sup>th</sup> (cf. Ulaanbaatar City use class 7 to 9, Seismic coefficient  $K_h=0.10$ )

Therefore, The seismic horizontal coefficient ( $K_h$ ) for the Project may also adopt 0.10 for Arterial Road.

4. Date: Jul.25, 2001 (at Erel Cement Factory, Darkhan)  
Attendance: Mr. Bataa TSERENBALJIR Director, EREL CEMENT  
Mr. Y. Takai Bridge Engineer, Study Team  
Mrs. Amarjargal, Interpreter

Subject: Production of Cement Materials

Mr. Tserenbaljir said Mr. Takai, there are two cement factory in Mongolia, this factory and location of Erdenet. Also, Mr. Tserenbaljir informed that the quantity of cement production is 75,000 ton per year. Mr. Takai asked Mr. Tserenbaljir the quality of producing cement. Mr. Tserenbaljir informed Mr. Takai the cement products almost 400 kg/cm<sup>2</sup> strength (4cm cube) conforming to Standard of American



AASHTO currently.

5. Date: Jul.25, 2001 (at Metallurgical Kombinat, Darkhan)

Attendance: Mr. Y. Fujimoto, JICA Expert

Mr. Y. Takai Bridge Engineer, Study Team

Mrs. Amarjargal, Interpreter

Subject: Production of Reinforcing Steel Bar

Mr. Takai asked Mr. Fujimoto the quantity of production for reinforcing bars per year.

Mr. Fujimoto replied to Mr. Takai that the quantity of reinforcing bars is 6,000 to 8,000 ton per year, 14,000 ton per year including L-angle plates. The production of steel bars is only this metallurgical kombinat in Mongolia.

Mr. Fujimoto said the quality test of steel bars is in accordance with JIS, Japanese Standard. And, the kinds of diameter for deformed steel bars are dia.10,13,16,19,22,25,29,32mm and 12,20mm for round bars at present. The quality for reinforcing bars is SD 390 with chemical analysis.

6. Date: Sep.28, 2001

Subject: Pile Driving Equipment

Results of Interviewing on Existence of a Pile Driver in Mongolia

- "Ganguur" Co., ltd. Chief Engineer Mr. Bazargur

They have a Russian-made new pile driving diesel hammer able to drive a pile with a cross-section of up to 50cm square and length of up to 12m.

- "Us Oyu" Co., Ltd. Director Mr. Ganbold

They have a drilling machine able to bore a 495mm- diameter hole with the use of a 520mm- diameter driving pile.

## **C-2    Results of Inventory Survey of Existing Bridge**

**Table-A Bridge Inventory Sheet (Sheet No. 1-1)**

Name of Bridge	Bridge No.1 (Khujirt River)		Crossing River/Road		*River (Khujirt)	Date of Inspection	Apr 25 & 28, 2001	Inspection by	Y. Takai, B. Enkhiaivan
Km Post	117.0km		Baganuur City		Russian	Date of Construction	1970s	Maintenance by	
Type of Bridge	Superstructure		Reinforced Concrete (RC) Slab (panels)			Russian Standard, H-30, HK-80		Load limitation	*No
	Substructure		Abutment		RC Wall				Yes
			Pier		RC Wall				
Length of Bridge			9.2m Span		2@4.6m				
Width of Bridge	Overall		15.6m		Carriage: 6.7m	Pedestrian			
Affixed articles	Kind				Number				
Traffic Volume			617 Veh./day		Ratio of Heavy Veh. 8.4% (52)				
Final Record of Repair	Pavement		Deck Slab		Main Beam	Painting			
	Substructure								

Component	Conditions Of Damage		Rating	Component	Conditions of Damage		Rating
	Good, *Wave, Rut, *Crack, Pothole, Others	Others: Settled approach embankment			Good, Crack, *Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Line water leaking at surface	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others	
Surface	Pavement	Good, *Wave, Rut, *Crack, Pothole, Others	2	Abutment	Good, Crack, *Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Line water leaking at surface	2	
	(Type: Asphalt)			(Type: RC Wall)			
	Curb	Good, Scale, Crack, Spall, Rebar-exposed, Others	1	Abutment	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
	(Type: RC)			(Type: )			
	Railing	Good, Scale, Crack, Spall, Rebar-exposed, Others		Pier	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Line water leaking at surface, Gap due to construction joint	2	
Super-Str	(Type: None)			(Type: RC Wall)			
	Deck slab	Good, Honeycombs, Crack, Deformation, Rebar-exposed, Other	3	Pier	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
	(Type: RC Slab)			(Type: )			
	Main Beam	Good, Honeycombs, Crack, Deformation, Rebar-exposed, Other		(Type: )	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
	(Type: )			(Type: )	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
Accessory	Cross Beam	Good, Crack, Deformation, Rebar-exposed, Others		(Type: )	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
	(Type: )			(Type: )			
	Painting	Condition		(Type: )	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others		
	Exp-Joint	Good, Abnormal Sound, Deformation, Gap, Broken, Others		SOUNDNESS EVALUATION RATING			
	(Type: None)			1. No damage detected on the basis of the inspection results.			
Accessory	Shoe	Good, Abnormal Sound, Deformation, Gap, Broken, Others		2. Damage has been detected and a follow-up survey is required.			
	(Type: None)			3. There is significant damage and a detailed survey needs to be carried out to establish whether repair work is to be carried out or not.			
	Drainage	Good, Clogged Leakage, Broken, Others		4. There is significant damage and urgent repair is required or the bridge/culvert has to be closed to traffic or restriction on vehicle weight to be imposed.			
	(Type: None)			(or to be re-constructed new bridge/culvert)			
	<Existing conditions of bridge/culvert>						

See Table- C photograph		<Remarks> Mark * : Correspond Defects
		Approach pavement and retaining walls shall be required.
		Detailed survey for the slab shall be required.

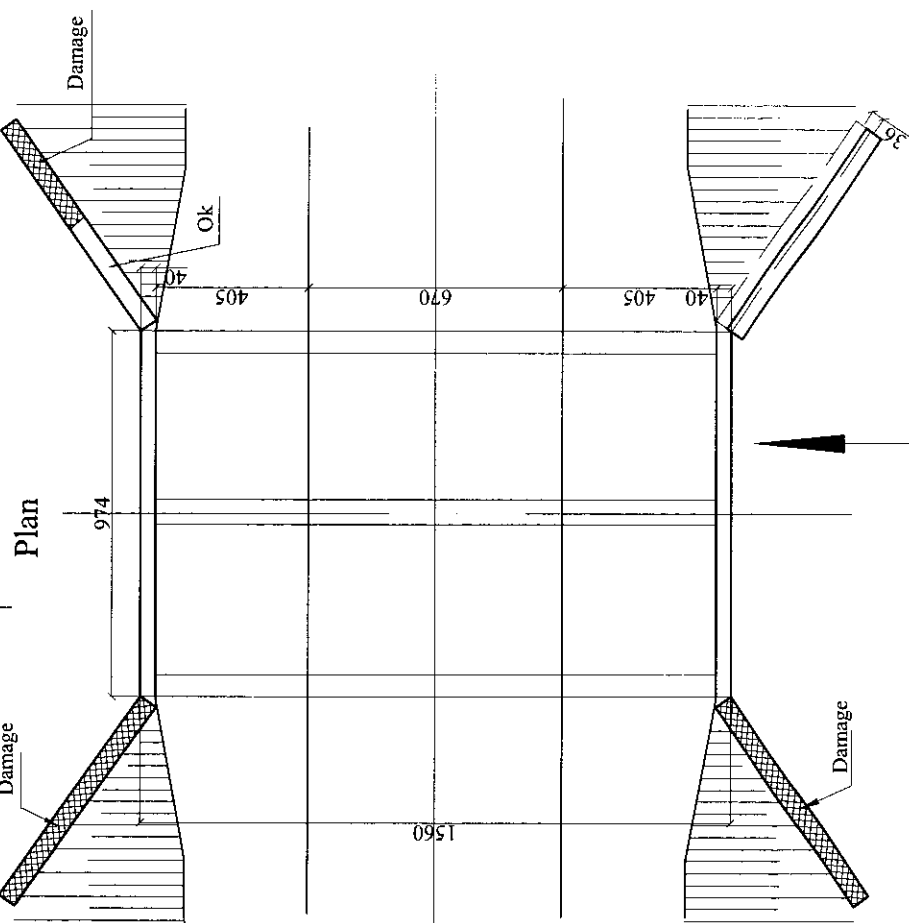
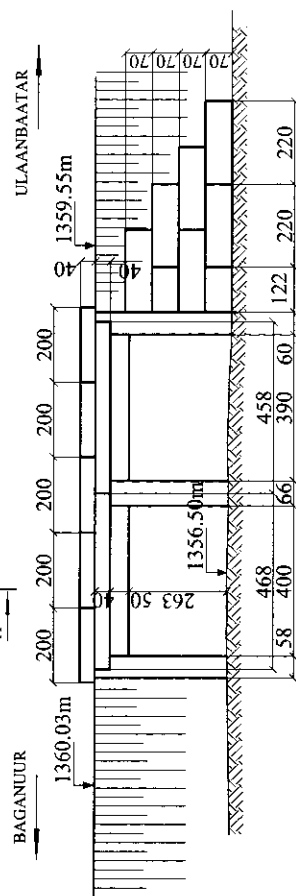
Table B Bridge Sketch Sheet (Sheet No. 1-2)

General View and Damage Conditions

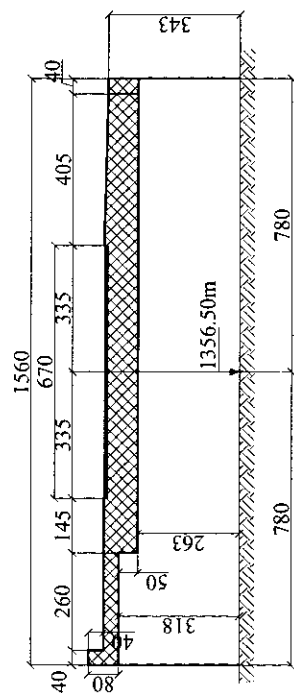
Profile

Scale 1:200

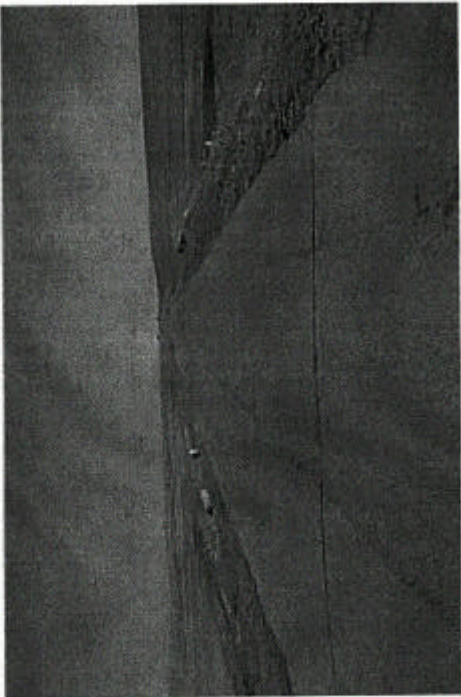
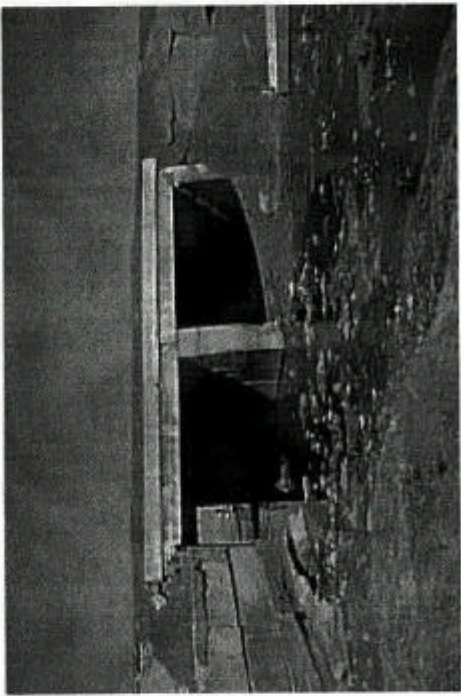

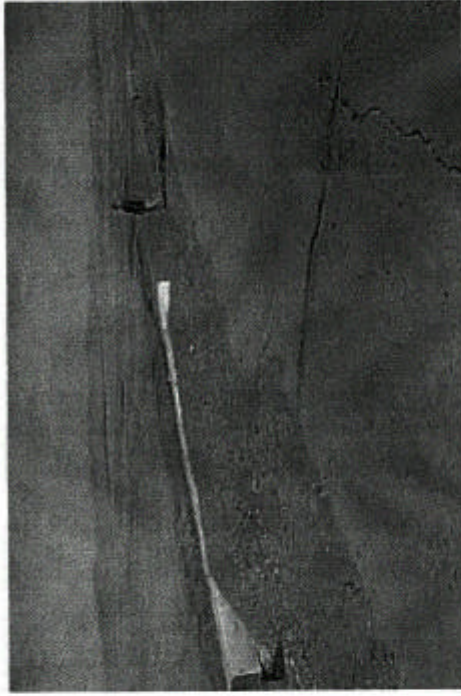
Dimension: centimeter



Section A-A

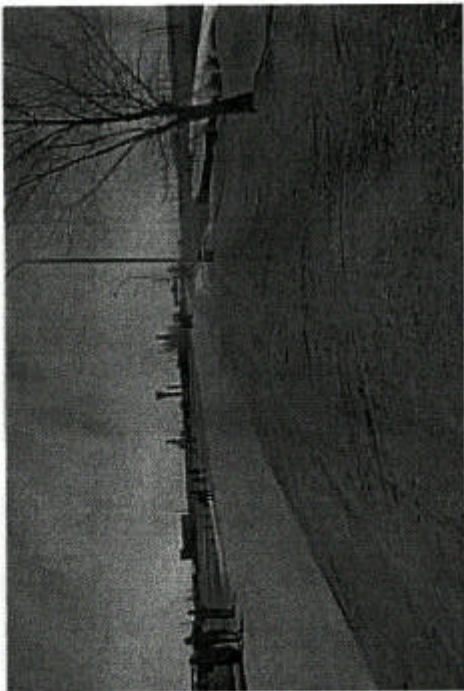
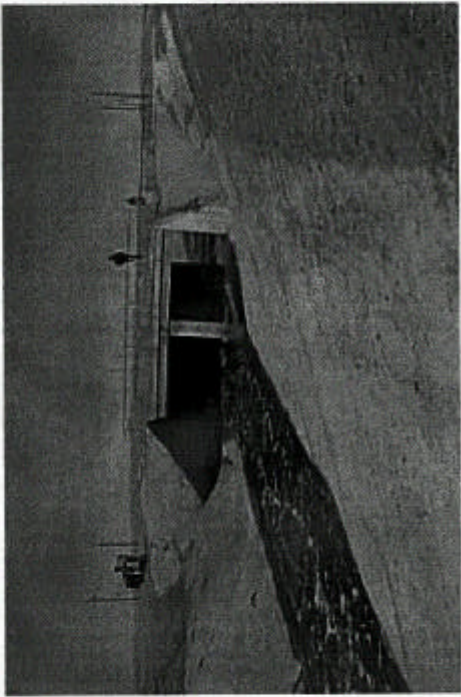



**Table-C Photograph Sheet (Sheet No. 1-3)**

Kind of Photograph		1. Bridge No.1		2. Others		Date of Photograph		Photograph By: Y.Takai		Comment of Photo	
Location / Place :		Baganuur RC Slab Bridge		117.0km		Apr.25, 2001		Location / Place :		Profile (from Down Stream)	
05	Location / Place:									Bridge Surface	
07	Location / Place:									Profile (from Down Stream)	
08	Location / Place:									Bridge Surface	
09	Location / Place:									Bridge Surface	



**Table-C Photograph Sheet (Sheet No.1-3') (Reference for DOR Route)**

Kind of Photograph		Date of Photograph		Photograph By: Y.Takai	
1. Bridge No.1'		2. Others			
Location / Place :		Location / Place :		Location / Place :	
	<p>Comment of Photo</p> <p>Bridge surface</p> <p>♦ Fair Conditions for structures</p>	<p>Comment of Photo</p> <p>Profile</p> <p>Water-way constructed concrete panels</p>		<p>Comment of Photo</p> <p>Pier, abutment, retaining wall</p>	
21	Location / Place:	20	Location / Place:	23	Location / Place:

**Table-A Bridge Inventory Sheet (Sheet No. 2-1)**

Name of Bridge	Bridge No.2 (Khursaa River)		Crossing River/Road		*River (Khursaa)		Date of Inspection	Apr.19, 25, 2001	Inspection by	Y. Takai, B. Enkhnaivan		
Km Post	137.2km		Baga nuur City		Construction by Mongolian / Russian		Date of Construction	1995	Maintenance by			
Type of Bridge	Superstructure	Wooden deck slab, wooden beam		Design Loading			Russian Standard, H-18		Load limitation	No		
	Substructure	Abutment		Wooden pile, wooden board		Design Standard	BS	AASHTO	*RUSSIA	OTHERS( )	*Yes	
		Pier		Wooden pile		Skew of Bridge	*Square	Skew	Curve (deg.R= )			
Length of Bridge	14.7m		Span		8.75+3.8m		Condition of Crossing					
Width of Bridge	Overall	6.1m		Carrage	5.6m		Pedestrian					
	Kind			Number								
Affixed articles	356		Veh./day	Ratio of Heavy Veh.		4.8% (17)						
Traffic Volume							Others					
Final Record of Repair	Pavement	Deck Slab	Main Beam	Painting			Expansion Joint	Bearing	Drainage	Railing	Curb	
	Substructure											

Component	Conditions Of Damage	Rating	Component	Conditions of Damage	Rating
Pavement	Good, Wave, Rut, Crack, Pothole, Others	4	Abutment	Good, Crack, Spall, *Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Inclined and settled pile.	4
(Type: None)			(Type: Wooden)		
Curb	Good, Scale, Crack, Spall, Rebar-exposed, Others		Abutment	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Inclined and settled pile.	
(Type: Wooden beam)			(Type: )		
Railing	Good, Scale, Crack, Spall, Rebar-exposed, Others	4	Pier	Good, Crack, Spall, *Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Inclined and settled pile.	4
(Type: wooden beam)			(Type: Wooden)		
Deck slab	*Deformation		Pier	Good, Crack, Spall, Deformation, Rebar-exposed, Broken, Settlement, Scouring, Others: *Inclined and settled pile.	
(Type: Wooden board)			(Type: )		
Main Beam	Good, Honeycombs, Crack, *Deformation, Rebar-exposed, Other	4	(Type: )		
(Type: Wooden beam)			(Type: )		
Cross Beam	Good, Honeycombs, Crack, *Deformation, Rebar-exposed, Other	4	(Type: )		
(Type: Wooden beam)			(Type: )		
Painting	Good, Crack, *Deformation, Rebar-exposed, Others	4	(Type: )		
Condition			(Type: )		
Exp.Joint	Good, Abnormal Sound, Deformation, Gap, Broken, Others		SOUNDNESS EVALUATION RATING		
(Type: )			1. No damage detected on the basis of the inspection results.		
Shoe	Good, Abnormal Sound, Deformation, Gap, Broken, Others		2. Damage has been detected and a follow-up survey is required.		
(Type: )			3. There is significant damage and a detailed survey needs to be carried out to establish whether repair work is to be carried out or not.		
Drainage	Good, Clogged Leakage, Broken, Others		4. There is significant damage and urgent repair is required or the bridge/culvert has to be closed to traffic or restriction on vehicle weight to be imposed.		
(Type: )			(or to be re-constructed new bridge/culvert)		
<Existing conditions of bridge/culvert>			<Remarks> Mark * : Correspond Defects		
See Table-C photograph			Considering alignment and location, wooden bridge shall be re-placed to the permanent RC type.		

## General View and Damage Conditions





## General View and Damage Conditions

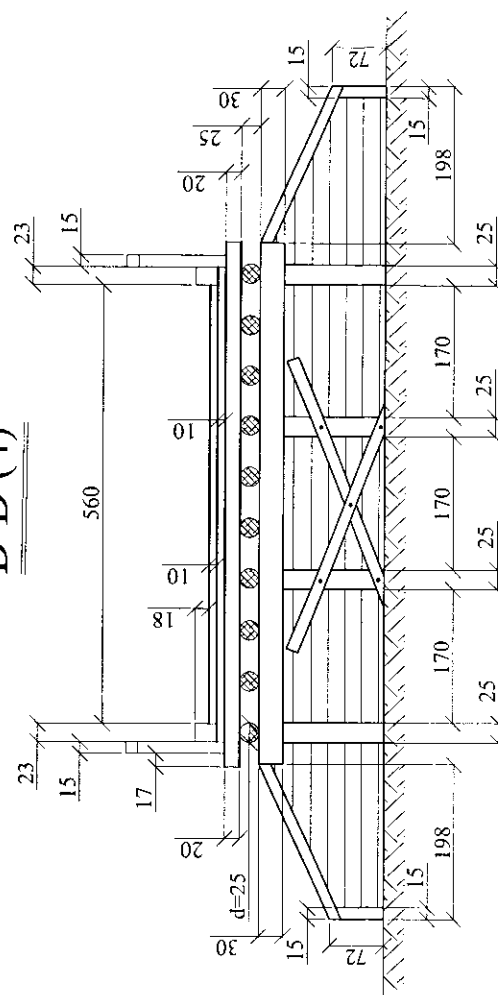
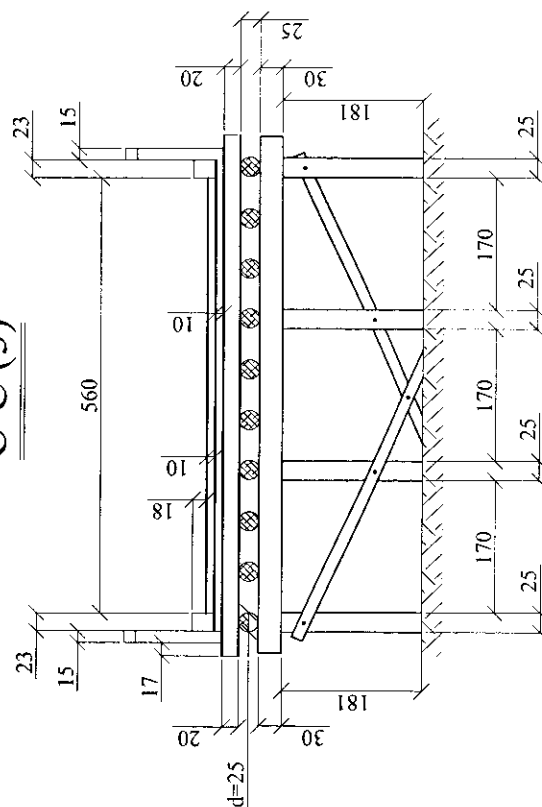
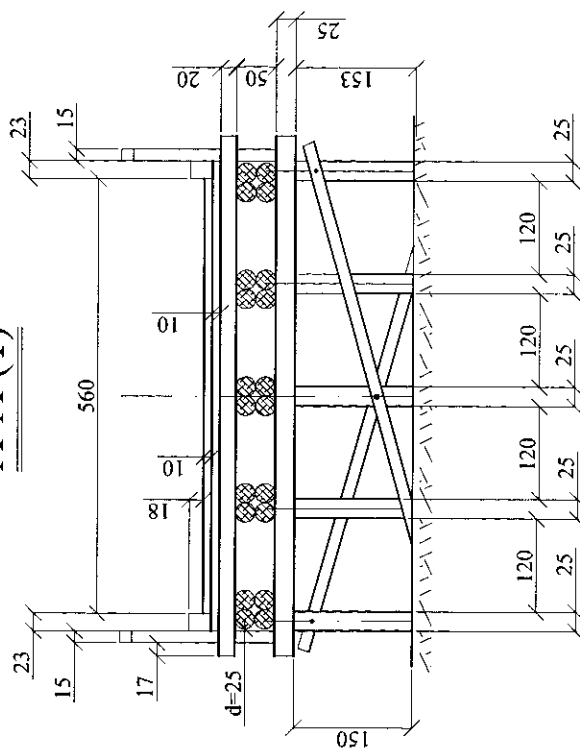


Table-C Photograph Sheet (Sheet No. 2-4)






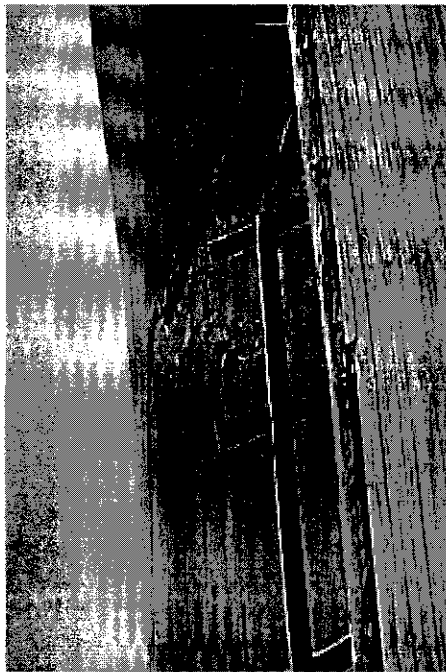
Kind of Photograph		Date of Photograph		Photograph By: Y. Takai	
1. Bridge No.2		Apr.19,24, 2001			
Location / Place :		Location / Place :			
2. Others		137.2km			
Baganuur Wooden Bridge					
		<p>Comment of Photo</p> <p>Bridge Surface</p> <p>* Big Gap between approach and bridge surface due to settlement of embankment</p>			
24		25			
<p>Location / Place :</p> 		<p>Comment of Photo</p> <p>Wooden Pier</p>		<p>Location / Place :</p> 	
26		27			
		<p>Comment of Photo</p> <p>Wooden Abutment</p> <p>* Inclined retaining wooden wall due to flood</p>			

Table-C Photograph Sheet (Sheet No. 2-5)

Kind of Photograph		1. Bridge		2. Others		Photograph By	
Location / Place :		Date of Photograph		Location / Place :		Comment of Photo	
012		Down Stream Side ♦ Natural river way		013		Up Stream Side	
Location / Place :		Comment of Photo		Location / Place :		Comment of Photo	