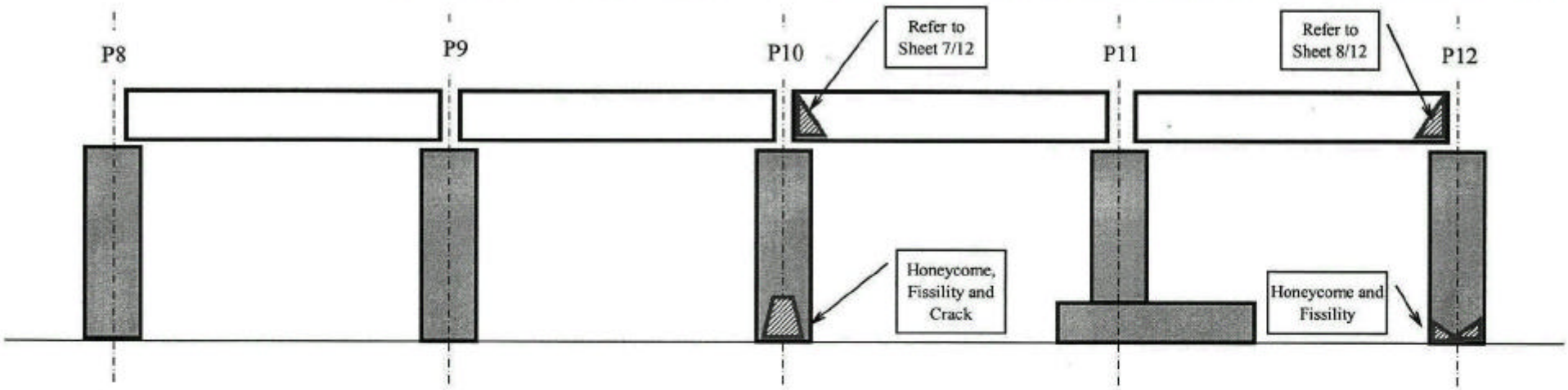
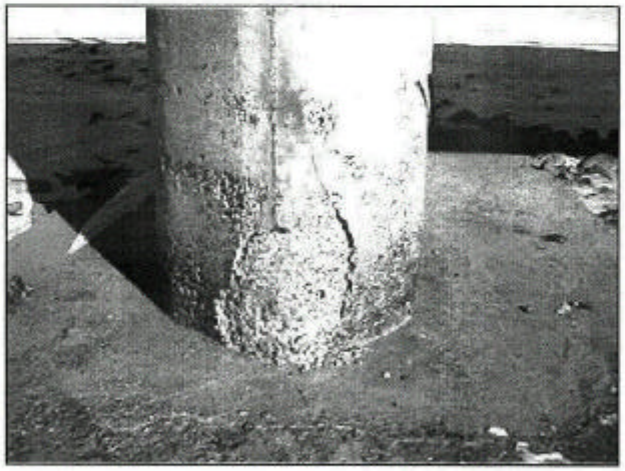
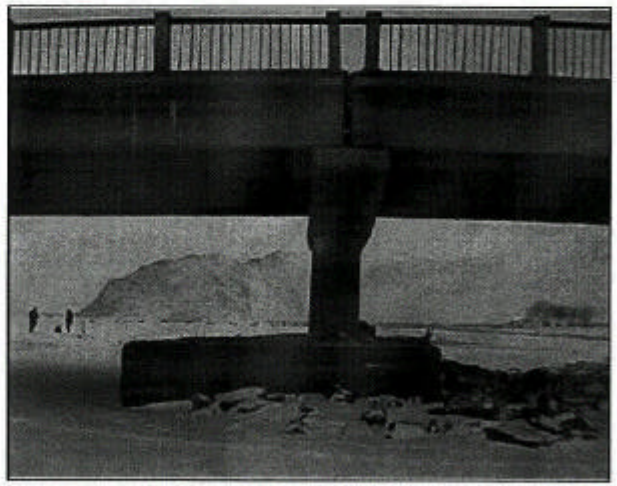
Inventory Sheet (Existing Kherlen River Bridge 9/12)

Bridge	Kherlen River Bridge	River	Kherlen	km post :	142 + 424	Date	4 Dec. 2001	Taken By:	Y.Takai / H. Nakano
Existing Structure	RC-T Girder Bridge								

Sketch Plan A1-P4



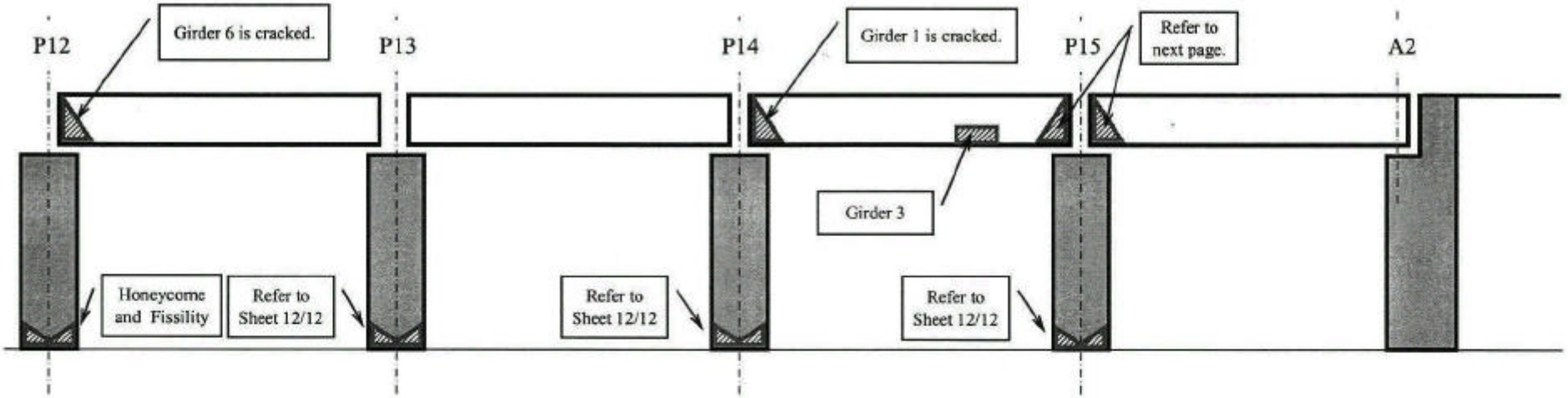
Comments :

Photo 1	Photo 2	Photo 3
		
Comments : Pier 10, Crack and Honeycome are found at the bottom part.	Comments : Pier 10, Fissility at the downstream part.	Comments : Pier 11 from upstream

Inventory Sheet (Existing Kherlen River Bridge 10/12)

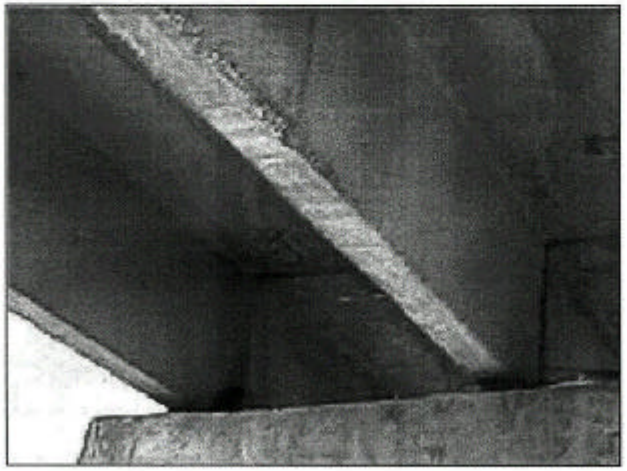
Bridge	Kherlen River Bridge	River	Kherlen	km post :	142 + 424	Date	4 Dec. 2001	Taken By:	Y.Takai / H. Nakano
Existing Structure	RC-T Girder Bridge								

Sketch Plan A1-P4



Comments :

Photo 1

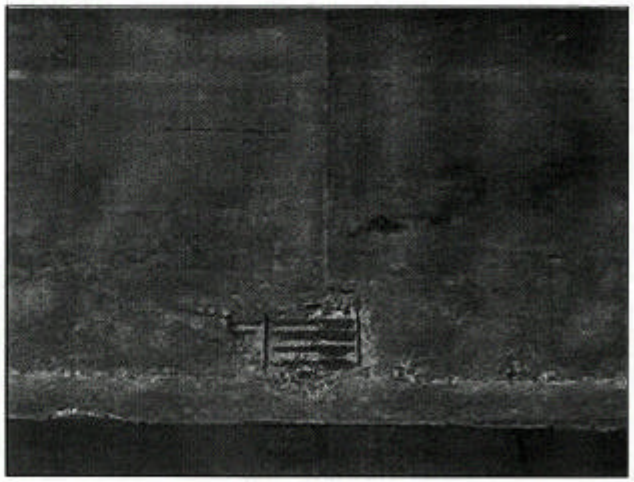


Comments : Pier 12, Girder 6

Photo 2

Comments : Pier 14, Girder 1

Photo 3

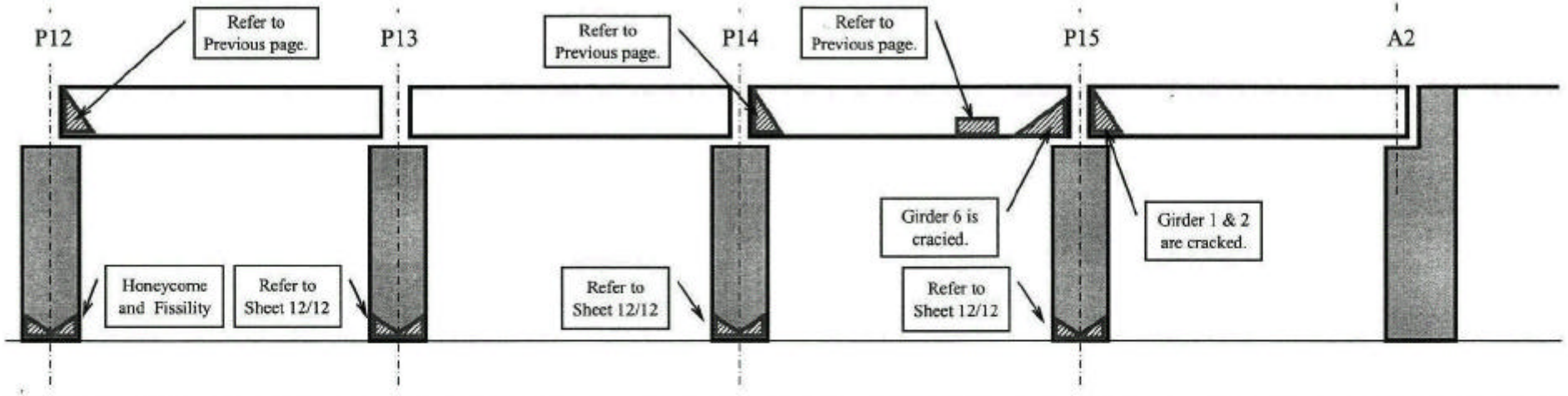


Comments : Re-bar exposed on girder 3 between Pier 14 & 15.

Inventory Sheet (Existing Kherlen River Bridge 11/12)

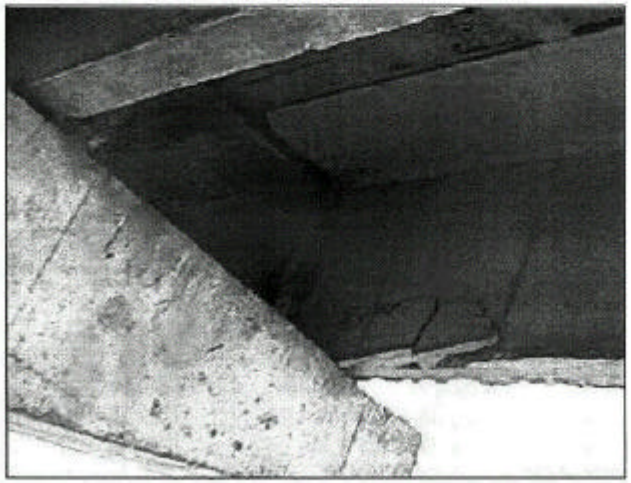
Bridge	Kherlen River Bridge	River	Kherlen	km post :	142 + 424	Date	4 Dec. 2001	Taken By:	Y.Takai / H. Nakano
Existing Structure	RC-T Girder Bridge								

Sketch Plan A1-P4



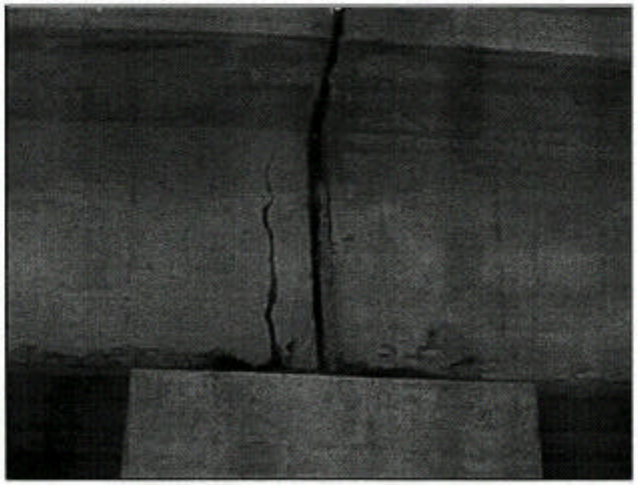
Comments :

Photo 1



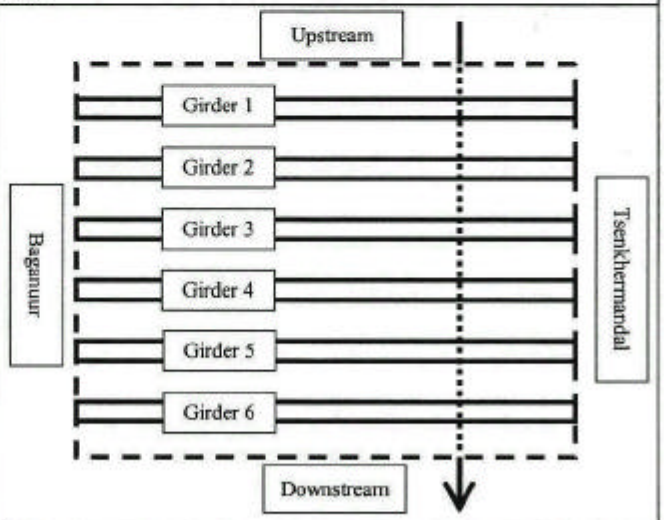
Comments : Pier 15, Girder 6

Photo 2



Comments : Pier 15, Girder 1

Photo 3

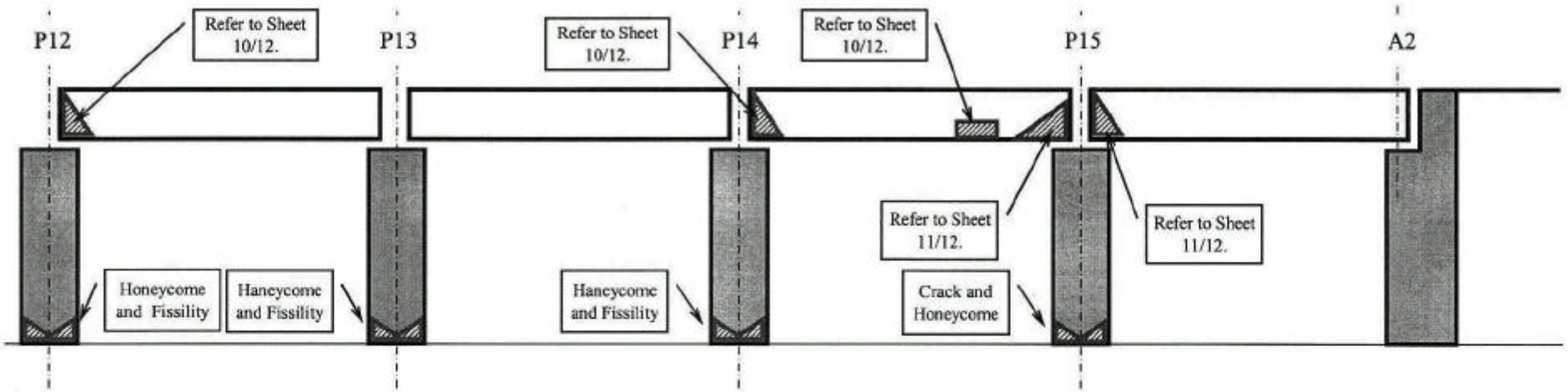


Comments :

Inventory Sheet (Existing Kherlen River Bridge 12/12)

Bridge	Kherlen River Bridge	River	Kherlen	km post :	142 + 424	Date	4 Dec. 2001	Taken By:	Y.Takai / H. Nakano
Existing Structure	RC-T Girder Bridge								

Sketch Plan A1-P4



Comments :

Photo 1

Comments : Pier 13, Honeycome and Fissility at the bottom end.

Photo 2

Comments : Pier 14, Honeycome and Fissility at the bottom end.

Photo 3

Comments : Pier 14, Crack and Honeycome at the bottom end.

C-4 Calculation Results of Strength for Kherlen Bridge

A. Existing Bridge (Applying Overseas Live-Load)

Live Load	Strength (kg/cm2) σ c (Concrete) σ s (Re-bar)	Force and Strength			
		Moment M (tfm)	Reinforcing Bar As (cm2)	Working Strength σ	Allowable Strength σ a
Slab					
Mongolia	σ c	1.52	Dia.13-10 no./m As=12.67cm2	67	80
	σ s			1281	1400
Japan- A	σ c	2.62		115	80
	σ s			2200	1400
American AASHTO	σ c	2.39		105	80
	σ s			2013	1400
Japan- TL-14	σ c	1.55		68	80
	σ s			1302	1400
Girder					
Mongolia	σ c	88.4	Dia.29-10 no./ Girder As=64.24cm2	54	70-80
	σ s			1817	1800
Japan-A	σ c	102.8		62	70-80
	σ s			2111	1800
American AASHTO	σ c	92.5		56	70-80
	σ s			1901	1800
Japan- TL-14	σ c	85.8		52	70-80
	σ s			1763	1800
Pier-Beam					
Mongolia	σ c	152	Dia.29-15no./ Pier As=96.36cm2	73	70-80
	σ s			1770	1800
Japan- A	σ c	179		86	70-80
	σ s			2078	1800
American AASHTO	σ c	163		78	70-80
	σ s			1891	1800
Japan- TL-14	σ c	151		72	70-80
	σ s			1751	1800

Shoe-Bed	Strength (kg/cm2) τ	Force and Strength			
		Shearing Force (ton)	Re-Bar Area (cm2)	Working Strength τ	Allowable Strength τ a
Mongolia	τ	3.7	As=1070cm2	3.4	8.5
Japan- A		4.4		4.1	
AASHTO		4.0		3.7	
Japan- TL14		3.6		3.3	

Caisson Stability	Displacement (mm) δ Bearing capacity (tf/m2) Q	Bridge Direction			
		Normal Case		Seismic Case	
		Working	Allowable	Working	Allowable
Mongolia	δ	1.2	27	0.5	27
	Q	28.1	59	23.1	88
Japan- A	δ	1.6	27	00.5	27
	Q	32.5	59	23.1	88
AASHTO	δ	1.3	27	00.5	27
	Q	29.3	59	23.1	88
Japan- TL-14	δ	1.2	27	00.5	27
	Q	27.9	59	23.1	88

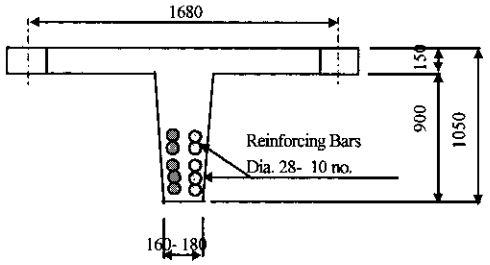
B. Reinforcement of Existing Bridge (Applying International Live-Load)

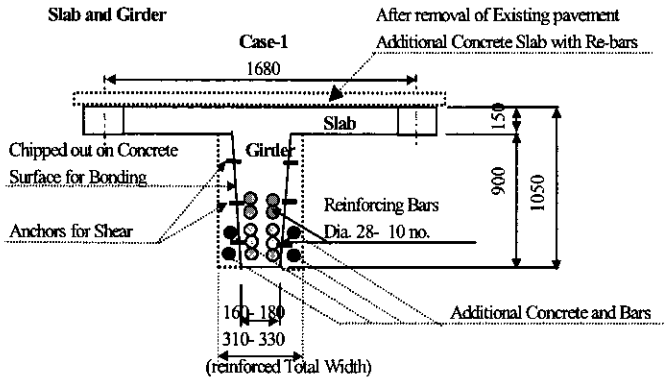
Live Load	Strength (kg/cm2) σ c (Concrete) σ s (Re-bar)	Force and Strength			
		Moment M (tfm)	Reinforcing Bar As (cm2)	Working Strength σ	Allowable Strength σ a
Slab (Increase thickness with RC concrete in total 20cm)					
Japan- A	σ c	2.47	Dia.13-10 no./m As=12.67cm2	58	80
	σ s			1396	1400
American AASHTO	σ c	2.26		53	80
	σ s			1280	1400
Girder (Increase web width with RC concrete in total 36cm)					
Japan- A	σ c	121.0	Dia.29-14 no./ Girder As=89.94cm2	54	70-80
	σ s			1656	1800
American AASHTO	σ c	110.8		49	70-80
				1516	1800
Pier-Beam (Increase beam width with RC concrete in total 1.80m)					
Japan- A	σ c	220.02	Dia.29- 23 no./ Pier As=147.75cm2	69	70-80
	σ s			1670	1800
American AASHTO	σ c	203.94		65	70-80
	σ s			1548	1800

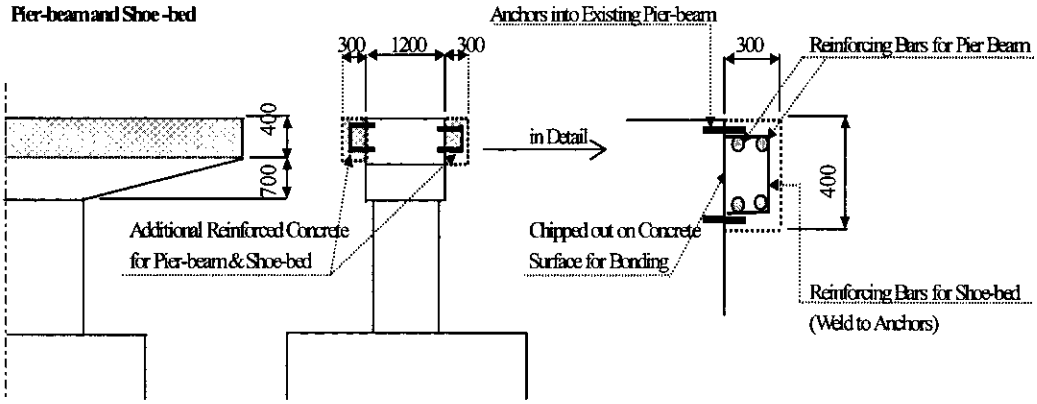
Figure for Bridge Calculations

For Table-A. Section of Existing Bridge

For Table-B. Section of Reinforcement of Bridge






Pier-beam and Shoe -bed
Anchors into Existing Pier-beam
300
1200
300
300
Reinforcing Bars for Pier Beam
400
700
in Detail
400
Additional Reinforced Concrete
for Pier-beam & Shoe-bed
Chipped out on Concrete
Surface for Bonding
Reinforcing Bars for Shoe-bed
(Weld to Anchors)

C-5 Breakdown of Cost Estimate

1. Breakdown of Bridge & Box Culvert

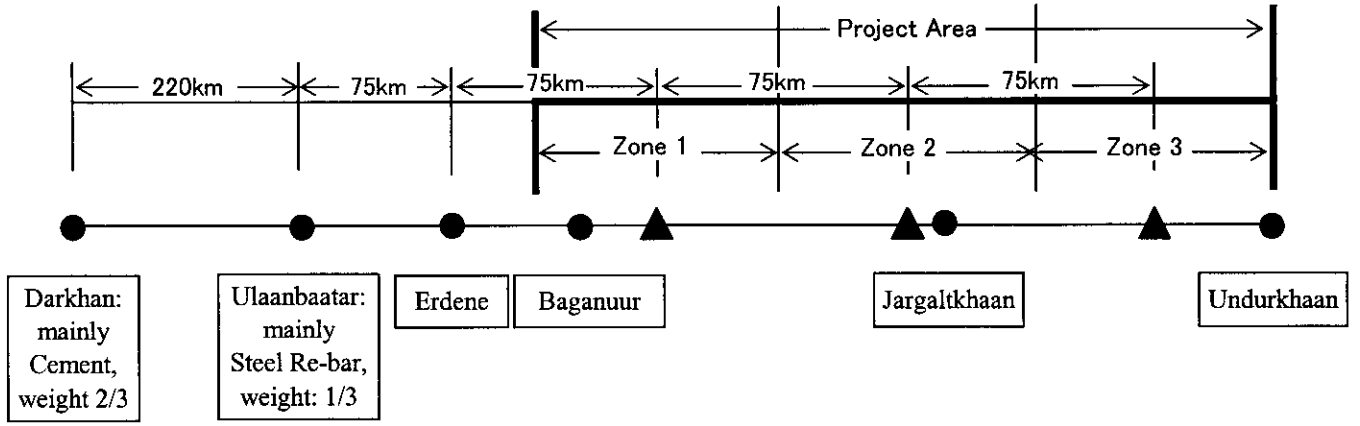
		unit	Unit Cost	Length	Width	Quantity	Direct Cost Quantity	Direct Cost Unit Cost	Direct Cost Cost	Indirect Cost except trans.	Indirect Cost Facility trans.	Indirect Cost Material trans.	Overhead	Total Cost
			$/m2	m	m	m2	n	$	$	$	$	$	$	
Bridge	B1	m2	687.79	15	9	135	1	93,000	93,000	18,600	9,300	4,900	10,100	136,000
	B2	m2	660.40	17.5	9	157.5	1	104,000	104,000	20,800	10,400	5,700	11,300	152,000
	B3	m2	733.50	268.8	9	2419.2	1	1,774,000	1,774,000	354,800	177,400	87,800	191,500	2,586,000
	B3(Repair)	m2	10.00	268.8	9	2419.2	1	24,200	24,200	4,800	2,400	-	2,500	34,000
	B4	m2	660.40	52.5	9	472.5	1	312,000	312,000	62,400	31,200	21,500	34,200	461,000
	B5	m2	756.57	15	9	135	1	102,000	102,000	20,400	10,200	6,100	11,100	150,000
	B6	m2	660.40	52.5	9	472.5	1	312,000	312,000	62,400	31,200	25,800	34,500	466,000
Sub-Total									2,721,200	544,200	272,100	151,800	295,200	3,985,000
Box	Type-D	-	-	-	-	-	12	18,000	216,000	43,200	21,600	22,600	24,300	328,000
	Type-E	-	-	-	-	-	12	26,000	312,000	62,400	31,200	34,500	35,200	475,000
	Type-F	-	-	-	-	-	5	33,000	165,000	33,000	16,500	18,600	18,600	252,000
	Type-G	-	-	-	-	-	0	43,000	0	0	0	0	0	0
Sub-Total									693,000	138,600	69,300	75,700	78,100	1,055,000
Direct Cost									3,414,200					
Indirect Cost	except transportation								682,800	682,800				
	Facility transportation:								341,400		341,400			
	Material transportation:								227,500			227,500		
Overhead									373,300				373,300	
Total Box & Bridge									5,039,000					5,040,000

Pipe Culvert

Pipe	Type-A	-	-	-	-	-	122	5,500	671,000	134,200	67,100	44,700	73,400	990,000
	Type-B	-	-	-	-	-	57	8,600	490,200	98,000	49,000	32,700	53,600	724,000
	Type-C	-	-	-	-	-	18	12,500	225,000	45,000	22,500	15,000	24,600	332,000
Direct Cost									1,386,200	277,200	138,600	92,400	151,600	2,046,000
Indirect Cost	except transportation								277,200					
	Facility transportation:								138,600					
	Material transportation:								92,400					
Overhead									151,600					
Total Pipe									2,046,000					

2. Breakdown of Material Transportation

Bridge	Zone	Quantity	From UB	From Darkhan	Equivalent Distance	Unit Cost	Cost
		ton	km	km	km	$/km·ton	$
B1	1	81	150	370	297	0.204	4,900
B2	1	95	150	370	297	0.204	5,700
B3	1	1,452	150	370	297	0.204	87,800
B3(Repair)	-	-	-	-	-	-	-
B4	2	284	225	445	372	0.204	21,500
B5	2	81	225	445	372	0.204	6,100
B6	3	284	300	520	447	0.204	25,800
							151,800
Type-D	1(6), 2(4), 3(2)	320	200	420	347	0.204	22,600
Type-E	1(3), 2(6), 3(3)	455	225	445	372	0.204	34,500
Type-F	1(1), 2(3), 3(1)	246	225	445	372	0.204	18,600
Type-G	0	0	225	445	372	0.204	0
							75,700
							227,500



3. LIST OF QUANTITY (Bridge)

Category	Material	Unit	Quantity						Total	Specification
			NO. 1-B1	NO. 2-B2	NO. 3-B3	NO. 4-B4	NO. 5-B5	NO. 6-B6		
Bridge Surface	Asphalt Pavement	m2	120	140	2150	—	—	—	2410	t=5cm, Khujirt to Kherlen Br.
	Concrete Pavement	m2	—	—	—	420	120	420	960	t=5cm, σ28=240kg/cm2, Tsenkher to Murun Br.
	RC Hand Rail	m3	12	14	209	42	12	42	331	σ28=240kg/cm2
	Reinfocing Bar for Rai	ton	1.0	1.1	16.7	3.4	1.0	3.4	26.6	SD295, 345, 390(σpy>30kg/mm2)
	expansion Joint	m	16	16	72	32	16	32	184	Rubber joint
Superstructure No. of Girder	Concrete (for RC)	m3	53	68	124	204	53	204	706	σ28=240kg/cm2
	Concrete (for PC)	m3	—	—	1304	—	—	—	1304	σ28=400kg/cm2
	Reinfocing Bar	ton	7.6	9.8	13.3	29.3	7.6	29.3	96.9	SD295, 345, 390(σpy>30kg/mm2)
	Prestressed Cable	ton	—	—	65.2	—	—	—	65.2	T-12.7mm(σpy=160kg/mm2)
	Leveling Concrete	m3	10.8	12.6	193.5	37.8	10.8	37.8	303.3	σ28=240kg/cm2
Substructure	Concrete	m3	257	250	1194	403	188	405	2697	σ28=210kg/cm2
	Reinfocing Bar	ton	15.4	15.0	71.6	24.2	11.3	24.3	161.8	SD295, 345, 390(σpy>30kg/mm2)
	Lean Concrete	m3	22.8	22.8	92.2	34.5	13.6	34.5	220.4	σ28=160kg/cm2
Pile Foundation (Square 40cm)	RC Pile Length(m)	m	—	—	—	—	432	—	432	σ28=240kg/cm2 SD295, 345, 390(σpy>30kg/mm2)
Structural Excavation	Up to 2m	m3	436	436	1804	710	316	710	4412	for Abutment, Pier
	Over 2m	m3	1281	1235	3384	1564	944	1570	9978	
Approach Road	Construction Earth	m	30	35	1000	105	30	105	1305	Average height 2m, width 5m
	Guide Post	no.	40	40	40	40	40	40	240	Concrete standard post
River Protection	Revetment	m2	366	345	141	345	335	356	1888	Stone pitched type, slope 1:1.5 or 1:2
	Guide Bank	m	200	200	200	200	200	200	1200	

LIST OF QUANTITY FOR REPAIR OF EXISTING BRIDGE

Category	Material	Unit	Quantity	Specification
			NO. 3-B3	
Bridge Surface	Asphalt Overlay	m2	1882	t=3cm
	Surface Repair	m3	4	with concrete σ28=240kg/cm2, joint parts
	Joint Repair	m	388	with asphalt material
	Hand Rail Repair	m	512	
	Hand Rail Replacement	m	26	Concrete & Reinforcing bar
Structures	Girder Crack Repair	m3	0.4	Concrete or mortar
	Pier Crack Repair	LS	0.2	Concrete or mortar
Approach	Surface Repair	m2	392	

4. LIST OF QUANTITY (Pipe Culvert)

Category	Location	Unit	Quantity			Total	Specification
			Type A	Type B	Type C		
Concrete (Pre-cast)	PipeCulvert	m3	3.80	8.55	17.11	29.46	σ28=210kg/cm2
	—	—	—	—	—	—	—
Reinforcing Bar (Pre-cast)	PipeCulvert	ton	0.11	0.26	0.51	0.88	SD295 (σpy>30kg/mm2)
	—	—	—	—	—	—	—
Concrete (Cast-in-situ)	Wall	m3	2.88	3.79	7.08	13.75	σ28=210kg/cm2
	Wing Wall	m3	9.06	14.71	14.71	38.47	σ28=210kg/cm2
	Sub-total	m3	11.94	18.50	21.79	52.23	—
Reinforcing Bar (Cast-in-situ)	—	m3	0.60	0.92	1.09	2.61	SD295 (σpy>30kg/mm2)
	—	—	—	—	—	—	—
Levering Concrete	—	m3	8.11	13.94	27.36	49.41	σ28=160kg/cm2
Gravel	—	m3	23.33	33.63	50.03	106.99	—
Stone Pitching	—	m2	52.47	68.78	81.38	202.62	—
Excavation	—	m3	54.10	79.34	119.71	253.15	—

5. LIST OF QUANTITY (Box Culvert)

Category	Location	Unit	Type D	Type E	Type F	Type G	Total	Specification
Concrete (Pre-cast)	Box Culvert	m3	34.00	58.70	83.40	117.45	293.55	σ28=210kg/cm2
	—	—	—	—	—	—	—	—
Reinforcing Bar (Pre-cast)	Box Culvert	ton	1.70	2.94	4.17	5.87	14.68	SD295 (σpy>30kg/mm2)
	—	—	—	—	—	—	—	—
Concrete (Cast-in-situ)	Wall	m3	3.26	6.20	9.14	10.09	28.68	σ28=210kg/cm2
	Wing Wall	m3	29.67	29.67	29.67	38.34	127.35	σ28=210kg/cm2
	Joint	m3	4.59	7.92	11.26	15.86	39.63	σ28=210kg/cm2
	Sub-total	m3	37.52	43.79	50.07	64.29	195.66	—
Reinforcing Bar (Cast-in-situ)	Wall & Wing Wall	m3	1.65	1.79	1.94	2.42	7.80	SD295 (σpy>30kg/mm2)
	Joint	m3	0.23	0.40	0.56	0.79	1.98	SD295 (σpy>30kg/mm2)
	Sub-total	m3	1.88	2.19	2.50	3.21	9.78	—
Levering Concrete	—	m3	29.09	47.57	66.05	83.85	226.56	σ28=160kg/cm2
Gravel	—	m3	58.97	82.70	106.43	130.70	378.80	—
Stone Pitching	—	m2	98.54	115.34	132.14	153.68	499.70	slope 1:2
Excavation	—	m3	130.92	182.37	233.82	286.72	833.84	—

7. Unit Cost of Major Materials (Structure)

1US$=1,100 Tg

Materials	Unit	Unit Cost			Remarks
		Foreign Portion (US$)	Local Portion (Tg.)	Total (US$)	
Portland Cement	kg	0.00	75,000	68.18	Domestic
Sand (for concrete)	m3	0.00	13,000	11.82	Domestic
Pea-gravel (for Concrete)	m3	0.00	21,000	19.09	Domestic
Admixture (for Concrete)*	kg	5.60	0	5.60	Imported
Sand (for Asphalt)	m3	0.00	13,000	11.82	Domestic
Aggregate (for Asphalt)	m3	0.00	21,000	19.09	Domestic
Straight Asphalt*	ton	61.53	0	61.53	Imported
Embankment Material	m3	0.00	12,700	11.55	Domestic
Reinforcing Steel (SD 30)	ton	0.00	497,310	452.10	Domestic
Plywood (12.5mm)	m2	0.00	17,000	15.45	Domestic
Timber Plank	m3	0.00	113,000	102.73	Domestic
Diesel Fuel	liter	0.00	725	0.66	Domestic
Gasoline	liter	0.00	751	0.68	Domestic
Lubricant	liter	0.00	1,943	1.77	Domestic
Paint	kg	0.00	2,152	1.96	Domestic
Rubber Shoe*	each	177.60	0	177.60	Imported
Expantin Joint*	m	539.20	0	539.20	Imported
PC Strand (12T12.7)*	kg	1.89	0	1.89	Imported

Notes : 1. Unit Costs of imported goods (marked *) are based on CIF price, i.e.
including port handing and clearance costs, plus Mongolian tax and duty.
2. Mongolian value added tax (VAT) is not included.

6. Unit Cost of Labours (Structure)

!US$=1,100 Tg

Classification	Unit Cost			Remarks
	Foreign Portion (US$/Day)	Local Portion (Tg./Day)	Total (US$/Day)	
Senior Field Engineer	0	21,000	19.09	Domestic
Skilled Labour	0	15,000	13.64	Domestic
Unskilled Labour	0	10,000	9.09	Domestic
Mason/Carpenter	0	18,000	16.36	Domestic
Equipment Operator	0	13,000	11.82	Domestic
Crane Operator	0	17,000	15.45	Domestic
Skilled Operator	0	15,000	13.64	Domestic
Driver	0	10,000	9.09	Domestic
Re-bar Specialist	0	12,000	10.91	Domestic
Electrician	0	13,000	11.82	Domestic
Welder	0	13,000	11.82	Domestic
Steeplejack	0	13,000	11.82	Domestic
Painter	0	19,000	17.27	Domestic
Guardman	0	13,000	11.82	Domestic