Table 2-3-23 Relation between Superstructure Type and Span Length

Type of Bridge		Span Length(m) 20	30	40	50	Girder height/ Length
RC Bridge	Simple Slab	═══				1/13~17
	Simple/continuous Hollow Slab	═══				1/17~20
	Simple T-shape Girder	═══				1/13~17
	Simple Box Girder		═══			1/18
	Continuous Box Girder			═══		1/20
PC Bridge	Simple Slab	═══				1/20
	Simple/continuous Hollow Slab	═══	═══			1/20
	Simple T,I-shape Girder		═══	═══	═══	1/15~18
	Simple/continuous Box Girder			═══	═══▶	1/18~22
Steel Bridge	Simple H-shape Beam		═══			1/22
	Simple I-shape Girder		═══	═══		1/17
	Continuous I-shape Girder		═══	═══	═══	1/18
	Continuous Box Girder				═══▶	1/18~20

(═══ :Applied Type to the Project)

Regarding the type of superstructure, many RC T shape bridges were constructed in the past and at present on account of availability of cement and aggregate in Mongolia.

On the other hand, steel bridges has not been constructed due to higher cost and necessity of maintenance (repainting).

Therefore, the concrete type bridge is adopted for this Project.

The scale of bridge in the Project is 51m length, and skew angle is 70 degrees.

The type and span arrangement of superstructure was compared with regard to river condition, topography and geology, economy, easier construction, construction period and disturbance ratio of river characteristics under two cases as shown in Table 2-3-24.

Case-A 3 Span 3@17m (Application to RC Girder)
Case-B 2 Span 2@25m (Application to PC Girder)

From the above results of selection for bridge type, RC girder type (case-A: 3@17m span) for the Selbe bridge is applied in terms of economy, construction (erection of equipment, period), availability of materials, maintenance and river characteristics.

As shown in the next Table 2-3-25, the types of superstructure for Selbe bridge were compared for 3 cases. RC T shape girder shall be applied to the Project considering easier fabrication and construction, easier erection and stability.

- Details of Superstructure Design

  * The maximum diameter of deformed reinforcing bar is selected as 29 mm based on the availability in domestic market and structural aspect.

  * The bearing shoe and expansion joint shall be made of rubber on account of no maintenance. The handrail shall be made use of aluminum alloys from the viewpoints of landscape and no maintenance.

  * The asphalt pavement shall be applied to a thickness of 7 cm.

Table 2-3-24 Comparison of Bridge Span and Type

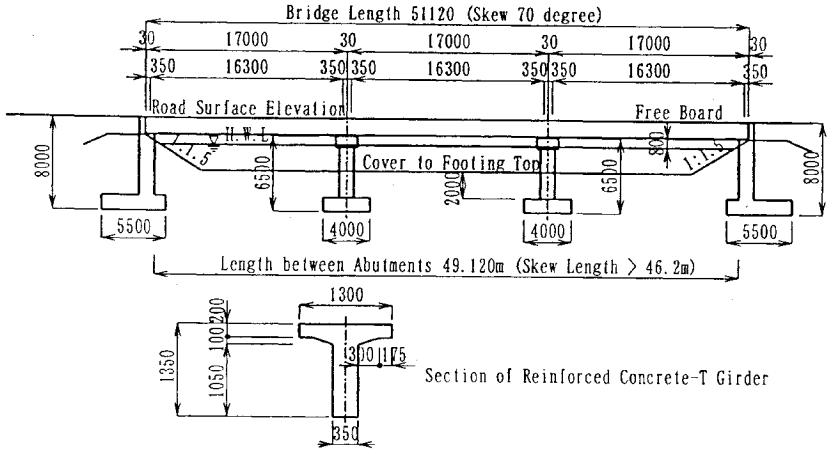
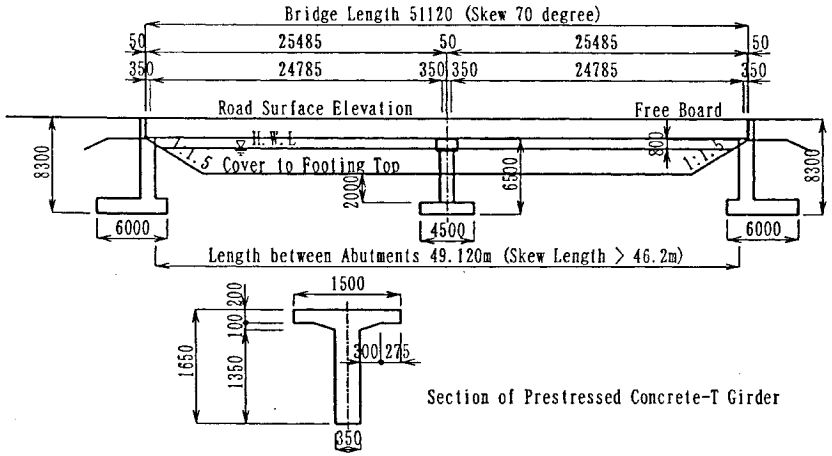
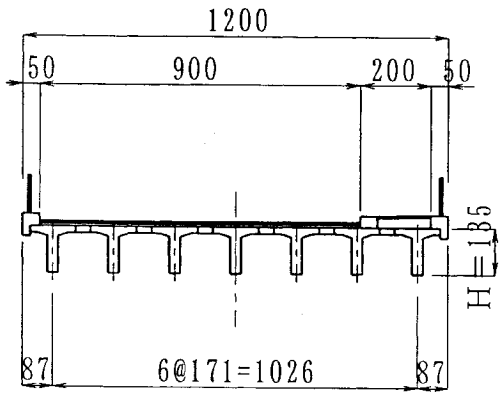
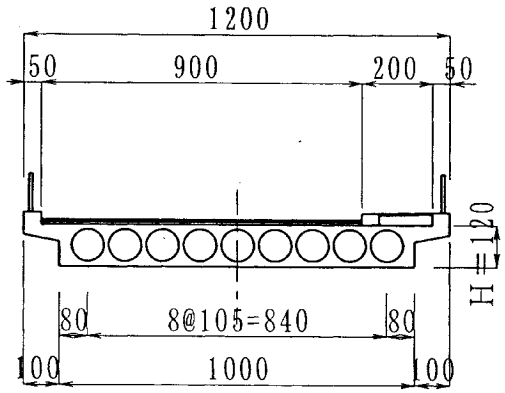
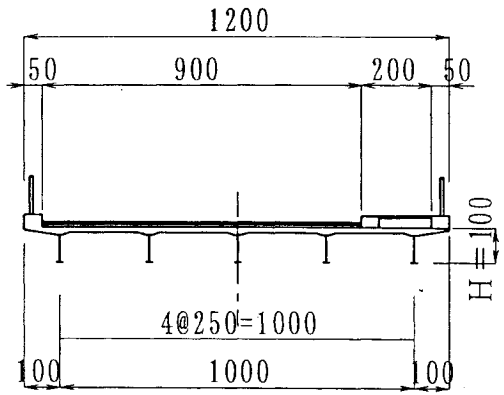
	General View	Characteristic	Adopt
Case A: 3 Span RC-T Girder		1. Construction Cost Economical (Ratio 1.00) 2. Construction Fabrication of beam: easier Beam weight 28ton, erection: easier 3. Approach Road elevation: lower than CaseB 4. River Widh of piers/river section ratio:5.2% There are 5 bridges on Selbe river. Existing bridges:1span length @11.4m 5. Others Beam (56no.) strength σ 28=240kg/cm2 Period is same as CaseB	Fair
Case B : 2 Span PC-T Girder		1. Construction Cost Not economical (Ratio 1.23) 2. Construction Fabrication of beam: required control for PC tension Beam weight 52ton, erection: heavy 3. Approach Road elevation: higher than CaseA 4. River Width of piers/river section ratio:3.9% 5. Others Beam (48no.) strength σ 28=350kg/cm2 period is same as CaseA (Tensionning work is required)	

Table 2-3-25 Comparison of Type of Superstructure

	Case-A: Reinfoced Concrete T Girder		Case-B: Reinforced Concrete Hollow Slab		Case-C: Steel I Girder	
Cross Section of Superstructure (Span Length 16.3m)	Dimension: cm 		Dimension: cm 		Dimension: cm 	
Construction Cost	Good	Economical (1.00)	Good	Economical (1.00)	Not good	Not economical (1.38)
Construction	Good	Easier to construct (Girder weight 28 ton/no.)	Not good	Not easy to construct (Required support under girder)	Not good	Easiest to construct (Need skilled labors (assenbly, splice)
Construction Period	Not good	longer	Not good	longest	Good	Short
Structural Characteristics	* Many experiences of RC T girder construction * Fabrication at yard, easy to control * No maintenance		* No experience of RC hollow slab construction * Construction at site, affect to weather poor control for quality of materials * No maintenance		* No experience of steel I girder * Materials import from other country * Need future maintenance (re-painting)	
Evaluation	**Most appropriate**		Not good		Not good	

b) Applied Substructure Type

The type of substructure is selected based on the scale of superstructure (girder length, weight, etc.), the height of substructures, river section and geological conditions. The standard substructure types are shown in Table 2-3-26.

Table 2-3-26 Relation between Substructure Type and Height

Type of Abutment	Structure Height (m)			
	10	20	30	
Gravity				
Gravity/RC Reversed T				
Reversed T-shape				
Buttres				
Rigid Frame				
Box				

Type of Pier	Structure Height (m)			
	10	20	30	
Wall, Column				
Two-column				
Rigid Frame				

(═══ : Applied Type to the Project)

The type of abutment shall be reinforced concrete reversed-T type on account of superstructure scale with 17 m girder length, abutment height with 7 to 9 m, spread foundation, economy and easier construction.

The type of pier is classified into 3 types from the viewpoints of 6 to 7 m height and skew of 70 degrees at river alignment as shown in Table 2-3-27. In the Project, reinforced concrete T-shape type (elliptic column) shall be applied taking into account the economy, easier construction, hydrological condition and foundation type.

- Details of Substructure Design

  * The pier footing shall be embedded more than 2 m into the river bed. The protection such as gabion shall not be laid around piers because of no scouring location.

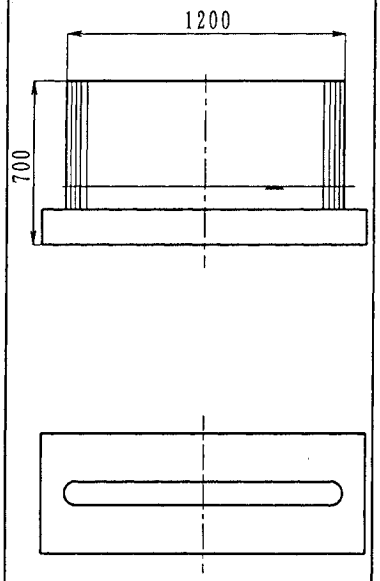
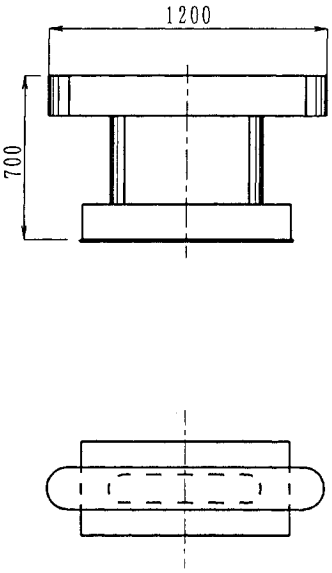
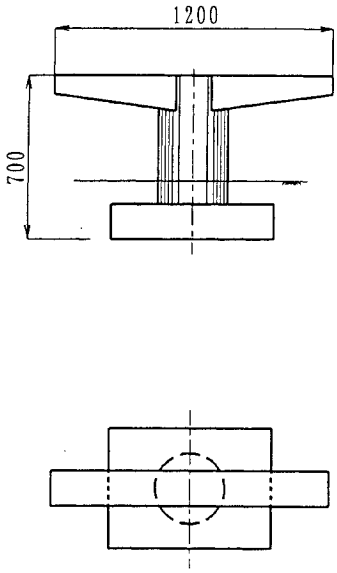
  * The abutment footing shall be embedded more than 2 m into the river bed. The revetment around the abutments shall be protected by

concrete block, and laid with stones (30 to 50 cm size) in front of revetment of river bed.

* The section of substructures shall be determined to use the maximum diameter-29 mm of deformed reinforcing bar on account of availability in the market.

* The top surface of footing shall not be tapered due to the easier construction.

Table 2-3-27 Comparison of Type of Pier

	Case-A: RC Wall	Case-B: RC Elliptic Column	Case-C: RC Cylindrical Column
Dimension of Pier (Section)	Dimension: cm 	Dimension: cm 	Dimension: cm 
Construction Cost	Not good (1.23)	Good (1.00)	Good (1.02)
Construction Period	Not good	Good	Good
Disturbance Rate	Good	Good	Not good
Adaptability to river flow	Not good	Not good	Good
Foundation Scale	Not good	Good	Good
Evaluation	Not good	**Most appropriate**	Not good

c) Applied Foundation Type

From the results of geological survey at bridge site, the bearing stratum for structural foundation is sufficient sand with gravel of more than 30 N-value.

Therefore, the type of foundation is to be spread footing. The under footing shall be laid with leveling concrete with thickness of 15cm.

4) Extension Method regarding Design Discharge (Q = 420 m^3/s) in Future Stage of Selbe River

The bridge length in the Project is 51.12 m three spans at a length of 16.3 m each.

In case of widening of river occurs with a design discharge of Q = 420 m^3/s in future stage, the bridge length shall be planned as 68.15 m by extending toward West side.

The west side abutment is systemized to pier, to be constructed new RC girder, abutment and revetment.

The structural countermeasure for systemizing to pier from abutment shall be as shown in the following Fig. 2-3-25.

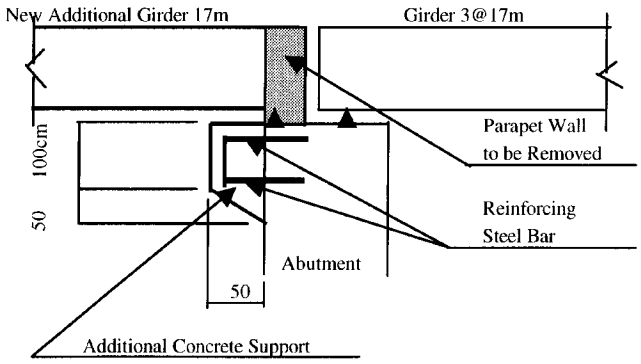


Fig. 2-3-25 Structural Countermeasure to Pier from Abutment

5) Drawing of Fly-over and/or Under-pass at Road and Intersection

The study of fly-over (F/O) and/or under-pass (U/P) at roads and intersections in Ulaanbaatar City was conducted in the FS study (1998). The plan, alignment and land space criteria for the F/O and/or U/P at Project location such as roads and intersections was also examined.

The studied locations in this Project are shown in Table 2-3-28. (and refer to appendices for more details)

Table 2-3-28 Locations of F/O and/or U/P in the Project

Location	Road Network	Requirement to Study
A : Western Rail Cross	Connect S-N Route of Outer Ring	Study in the Project
B : East Cross Intersection	S-N Route of Middle Ring	Study in the Project
C : West Cross Intersection	S-N Route of Middle Ring	*1 Difficulty due to geographic, land use
D : Teeverchid Western Part	Connect W-S Route	*2 F/o on Railway, in future stage
E : Teeverchid Central Market	S-N Route of Middle Ring	*3 F/O on railway, in future stage

* mark : summary only

A: F/O for Western Railway Crossing

- Condition : Clearance of railway 6.9 m
- Total length of F/O 457 m, Provisional width 10 m
- Embankment and RC U-shape retaining wall 317 m
  Bridge (F/O) 140 m (PC T-girder 4@35=140m, RC-3 piers, RC-2 abutments

A': U/P for Western Railway Crossing

- Condition: Clearance of Road 5.0 m
- Total length of U/P 370 m, width 25 m
  Approach U-shape retaining wall 3 m
  RC box 50 m
  Required drainage, electric facilities
  Construction period : long term
  Required excavation of big volume, switching rail alignment

B: East Cross Intersection

- Condition: Clearance of road 5.0 m
- Total length of F/O 608.2 m, width 10 m
  Embankment and gravity, RC U-shape wall 413.2 m
  Bridge (F/O) 195 m (PC box girder 60 + 75 + 60 = 195 m, RC-2 piers, RC-2 abutments)

C: West Cross Intersection

- Condition: Clearance of road 5.0 m
- Total length of F/O 450 m, width 10 m
  Approach 330 m
  Bridge (F/O) 120 m
- Problem:
  There is Seoul intersection located 200 m towards South from Peace Avenue. The approach end at the south side of F/O on Peace Avenue is not even with the surface of Seoul intersection. In case of extension of the F/O toward south side over Seoul intersection, a big volume of construction and huge cost shall be required. Moreover, it is difficult to acquire land along the F/O route.

D: Teeverchid West Part

- Condition: Clearance of railway 6.9 m
- Total length of F/O 680m, Width 10 m
  Approach 470 m
  Bridge (F/O) 210 m
- Problem:
  Detailed discussion with Railway Authorities construction shall be required on account of construction of F/O in railway ground. Therefore, the study for F/O will take long time to complete.

E: Teeverchid Central Market

- Condition: Clearance of railway 6.9 m , Road 5.0 m
- Total length of F/O 540 m, Width 10 m
  Approach 360 m
  Bridge (F/O) 180 m
- Problem:
  The F/O over railway and Teeverchid road near central market toward South area is of large scale.

(7) Revetment and Riverbed Protection

The river has a strong bend of 70^0 at the upstream, close to the bridge. The river stream may hit one bank first and move to other side. Hence, bank erosion is anticipated at the curved portions of both sides of the river. In order to protect the riverbank, revetments along both sides of the banks extending up to about 60 m upstream of the bridge and at downstream upto railway bridge are required. The base of the revetment is designed at 1.5 m below the riverbed considering the condition of river bed erosion. The foot portion of the revetment is also to be protected by mean of stone works. Still it is judged that riverbed erosion will not be so serious according to the information obtained at the site.

The riverbed protection around the bridge piers is not considered because the base of the bridge piers is to be constructed 2 m below the riverbed .

(8) Design Drawings

The following design drawings of Teeverchid Road and Dood Selbe Bridge are prepared and shown in Appendix 6-7.

2-3-4 Basic Design for Improvement of Intersections

(1) Traffic and Intersection Analysis

Number of lanes at each approach is determined based on intersection analysis, using the results of traffic survey at intersections. The degree of saturation at each intersection warrants to treat traffic at-grade as shown in Table 2-3-30.

The improvement of intersection will able to accommodate future traffic with annual growth rate of 5 % in next five years as shown in Table 2-3-29. As for East Crossroads intersection, the improved intersection will also able to cope with future traffic in next 10 years, even without grade separation structure because the degree of saturation does not exceed 0.9.

Table 2-3-29 Degree of Saturation

	East Crossroads	West Crossroads	In front of Geser Temple
5 years	0.662	0.767	0.821
10 years	0.845	-	-

(2) Layout of Channellization

The layout of intersection is designed based on determined number of lanes at each approach as well as geometric design criteria. Proposed layout of intersection is given in Appendix 6-7.

As for East Crossroads Intersection, the improved intersection will be able to accommodate future traffic in these 10 years. However, enough space for grade separation structure in future is kept in median considering the development of middle ring road.

(3) Pavement

The present surface condition of each intersection is well maintained to keep it smooth. The existing pavement is improved by overlay because surface condition is well and it is necessary to keep formation of all connecting roads at approaches. Accordingly, the improvement works are divided into two, namely overlay and new construction in widening section. The existing pavement section is improved by overlay, scarifying the existing surface and paving with a 10 cm thick wearing and binder course, while new pavement is built in widening section by excavating 50 cm deeper than subgrade level and constructing new subgrade and pavement structure.

(4) Road Incidental Works

Road incidental works such as markings, traffic signal, guardrail, street lighting and bus bay are to be installed to regulate traffic flow and secure traffic safety.

2-3-5 Basic Design for Procurement of Equipment

(1) Basic Plan of Procurement

There are 418.2 km of national roads, provincial roads, city roads, etc in Ulaanbaatar. The metropolitan government has the responsibility of maintaining/improving the roads. However, it has not been able to carryout the works judiciously due to lack of budget and equipment.

In May 1998, "The Road Fund in Ulaanbaatar" was revised; and a vehicle registration fee and a toll fee for vehicles entering Ulaanbaatar will able to be used to finance the maintenance/improvement works of the road network in the city.

Table 2-3-30 Result of Intersection Analysis (1/2)

The Result of Intersection Analysis
East Crossroad (After 5 Years)

Roads		A			B			C			D				
Direction		Right	Straight	Left	Right	Straight	Left	Right	Straight	Left	Right	Straight	Left		
Number of Lanes		1	2	1	1	2	1	1	2	1	1	2	1		
Basic Capacity (Veh./hour)		1,800	4,000	1,800	1,800	4,000	1,800	1,800	4,000	1,800	1,800	4,000	1,800		
Lane Width Factor		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
(Lane Width) m		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Vertical Gradient Factor		1.0	1.0	1.0	0.99	0.99	0.99	1.0	1.0	1.0	0.95	0.95	0.95		
(Vertical Gradient) %		1	1	1	−2	−2	−2	−1	−1	−1	2	2	2		
Heavy Vehicle Factor		0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97		
(Heavy Vehicle Rate) %		5	5	5	5	5	5	5	5	5	5	5	5		
(Pedestrian Factor) %		No Effective			No Effective			No Effective			No Effective				
(Effective Green Time) Second		22	22	22	18	18	18	12	12	12	14	14	14		
Saturation Flow Rate (Veh./hour)		1,746	3,880	1,746	1,729	3,841	1,729	1,746	3,880	1,746	1,659	3,686	1,659		
Traffic Volume (Veh./hour)		321	666	380	380	553	311	225	483	143	143	400	232		
Flow Ratio		0.184	0.172	0.218	0.220	0.144	0.180	0.129	0.124	0.082	0.086	0.108	0.140	Saturation of	Saturation of
Minimum Phase	1 ϕ			0.218										0.218	
	2 ϕ						0.180							0.180	0.662
	3 ϕ								0.124					0.124	
	4 ϕ												0.140	0.140	

The Result of Intersection Analysis
East Crossroad (After 10 Years)

Roads		A			B			C			D				
Direction		Right	Straight	Left	Right	Straight	Left	Right	Straight	Left	Right	Straight	Left		
Number of Lanes		1	2	1	1	2	1	1	2	1	1	2	1		
Basic Capacity (Veh./hour)		1,800	4,000	1,800	1,800	4,000	1,800	1,800	4,000	1,800	1,800	4,000	1,800		
Lane Width Factor		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
(Lane Width) m		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Vertical Gradient Factor		1.0	1.0	1.0	0.99	0.99	0.99	1.0	1.0	1.0	0.95	0.95	0.95		
(Vertical Gradient) %		1	1	1	−2	−2	−2	−1	−1	−1	2	2	2		
Heavy Vehicle Factor		0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97		
(Heavy Vehicle Rate) %		5	5	5	5	5	5	5	5	5	5	5	5		
(Pedestrian Factor) %		No Effective			No Effective			No Effective			No Effective				
(Effective Green Time) Second		54	54	54	44	44	44	31	31	31	34	34	34		
Saturation Flow Rate (Veh./hour)		1,746	3,880	1,746	1,729	3,841	1,729	1,746	3,880	1,746	1,659	3,686	1,659		
Traffic Volume (Veh./hour)		410	850	486	486	706	397	287	616	183	183	510	296		
Flow Ratio		0.235	0.219	0.278	0.281	0.184	0.230	0.164	0.159	0.105	0.110	0.138	0.179	Saturation of	Saturation of
Minimum Phase	1 ϕ			0.278										0.278	
	2 ϕ						0.230							0.230	0.845
	3 ϕ								0.159					0.159	
	4 ϕ												0.179	0.179	

Table 2-3-30 Result of Intersection Analysis (2/2)

The Result of Intersection Analysis
West Crossroad (After 5 Years)

Roads		A			B			C			D				
Direction		Right	Straight	Left	Right	Straight	Left	Right	Straight	Left	Right	Straight	Left		
Number of Lanes		1	3	2	1	2	1	1	3	1	1	2	1		
Basic Capacity (Veh./hour)		1,800	6,000	3,600	1,800	4,000	1,800	1,800	6,000	1,800	1,800	4,000	1,800		
Lane Width Factor		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
(Lane Width) m		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Vertical Gradient Factor		1.0	1.0	1.0	0.99	0.99	0.99	1.0	1.0	1.0	0.95	0.95	0.95		
(Vertical Gradient) %		1	1	1	−2	−2	−2	−1	−1	−1	2	2	2		
Heavy Vehicle Factor		0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94		
(Heavy Vehicle Rate) %		9	9	9	9	9	9	9	9	9	9	9	9		
(Pedestrian Factor) %		No Effective			No Effective			No Effective			No Effective				
(Effective Green Time) Second		32	32	32	23	23	23	26	26	26	22	22	22		
Saturation Flow Rate (Veh./hour)		1,692	5,640	3,384	1,675	3,722	1,675	1,692	5,640	1,692	1,607	3,572	1,607		
Traffic Volume (Veh./hour)		58	1,162	812	812	641	102	94	1,072	73	73	591	55		
Flow Ratio		0.034	0.206	0.240	0.485	0.172	0.061	0.055	0.190	0.043	0.045	0.165	0.034	Saturation of	Saturation of
Minimum Phase	1φ			0.240										0.240	
	2φ					0.172								0.172	0.767
	3φ								0.190					0.190	
	4φ											0.165		0.165	

The Result of Intersection Analysis
In front of Geser Temple (After 5 Years)

Roads		A			B			C			D				
Direction		Right	Straight	Left	Right	Straight	Left	Right	Straight	Left	Right	Straight	Left		
Number of Lanes		1	2		1	2	1	1	1	2	1	2	1		
Basic Capacity (Veh./hour)		1800	2000		1800	2000	1800	1800	2000	1800	1800	2000	1800		
Lane Width Factor		1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
(Lane Width) m		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Vertical Gradient Factor		1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
(Vertical Gradient) %		1	1		−1	−1	−1	−1	−1	−1	1	1	1		
Heavy Vehicle Factor		0.95	0.95		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95		
(Heavy Vehicle Rate) %		8	8		8	8	8	8	8	8	8	8	8		
(Pedestrian Factor) %		No Effective			No Effective			No Effective			No Effective				
(Effective Green Time) Second		18	18		27	27	27	53	53	53	40	40	40		
Saturation Flow Rate (Veh./hour)		1,710	3,800		1,710	3,800	1,710	1,710	1,900	3,420	1,710	3,800	1,710		
Traffic Volume (Veh./hour)		181	401		26	607	159	238	600	746	746	910	272		
Flow Ratio		0.106	0.106		0.015	0.160	0.093	0.139	0.316	0.218	0.436	0.240	0.159	Saturation of	Saturation of
Minimum Phase	1φ		0.106											0.106	
	2φ					0.160								0.160	0.821
	3φ								0.316					0.316	
	4φ											0.240		0.240	

However, the fund will not be sufficient to purchase new equipment. The condition of the roads are exasperated not only by the lack of equipment but also by the poor technical design and standard of the roads that were mostly constructed between 1960 - 1970, the harsh weather and the increased number of cars on the road. The procurement plan of the project will consider all these problems.

Moreover, the procured equipment under the project will be utilized for road maintenance works after the completion of the project.

1) Road Maintenance Plan in Ulaanbaatar

The actual length of Maintenance/improvement carried out in 1999 and cost spent, the road maintenance/improvement schedule and budget in 2000, and the plans for the following years are shown in Table 2-3-31. The details of the plan are as follows.

a) The plans include 2 km road construction for improvement of the road network in the urban areas.

b) The road maintenance works are mainly re-carpeting works or overlay works of 7 - 9 km per year.

c) Maintenance works for repairing of face cracks and patching of potholes approximately 60,000 - 80,000 km^2 a year. Especially 80 km Enkhtaivan Avenue (the Peace Avenue), located in the city center, the main road between the city and the airport will be maintained every year and the remaining portions of roads will be maintained in order of priority and will be covered in a 4 year cycle.

d) Road maintenance in the city is mainly carried-out by the Ulaanbaatar Road Construction/ Rehabilitation Company (UBZZ). UBZZ falls under the municipality of Ulaanbaatar, under the auspices of the city treasurer, and is 100 % financed by the city; it gets about 60 % of the road maintenance works financed by the city. The remaining 40 % go to the private sector.

The above plan is deemed acceptable due to the past record of the works, budget scale and performance. The Road Maintenance Plan by road sections is shown in Table 2-3-32.

Table 2-3-31 Ulaanbaatar City Road Maintenance Plan

		1999 (Result)		2000 (Budget)		2001		2002		2003		2004		2005	
		Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)	Amount (Mil.Tg)	Road length/area (km, m^2)
New road construction	UB Z Z			576	1.2	100	1.5	100	1.5	100	1.5	100	1.5	100	1.5
	Others	250	2.7	244	0.6	40	0.5	40	0.5	60	1.0	80	1.0	100	1.0
	Total	250	2.7	820	1.8	140	2.0	140	2.0	160	2.5	180	2.5	200	2.5
Road Improvement (Overlay etc.)	UB Z Z	61	1.4			250	4.5	290	5.0	300	5.5	320	6.0	360	6.0
	Others					170	2.5	190	2.5	200	2.5	220	2.5	240	3.0
	Total	61	1.4			420	7.0	480	7.5	500	8.0	540	8.5	600	9.0
Road maintenance (Pothole patching etc.)	UB Z Z	188	28,923	101	15,540	270	41,500	290	44,600	320	49,200	330	50,800	350	53,800
	Others	648	99,736	54	8,310	110	17,000	130	20,000	140	21,600	150	22,700	160	24,700
	Total	836	128,659	155	23,850	380	58,500	420	64,600	460	70,800	480	73,500	510	78,500
Others	UB Z Z					200		200		210		225		225	
	Others	44		280		200		200		210		225		225	
	Total	44		280		400		400		420		450		450	
Total	UB Z Z	249		677		820		880		930		975		1,035	
	Others	942		578		520		560		610		675		725	
	Total	1,191		1,255		1,340		1,440		1,540		1,650		1,760	

Table 2-3-32 Ulaanbaatar City Road Maintenance Plan (by Road Section)

	2001	2002	2003	2004	2005
Road Improvement (Overlay etc.)	Road to power station 4 (6.2 km) Shar Khad road (3.4 km) Tsagaan davaa road (2.7 km) **Total 12.3 km**	Chingis avenue (6.05 km) 1st khoroolol street (2.6 km) Orbit road (3.3 km) Road to power station 3 (1 km) **Total 12.95km**	Enkh Taivan avenue (5.65 km) Tolgoit road (5.2 km) Dand Gol Street (1.1 km) Denjin myanga road (2 km) **Total 13.95 km**	Enkh Taivan avenue (2.85 km) Ikh Toiruu (3.05 km) Sukhbaatar street (1.34 km) Zaluuchid avenue (2.0 km) Naadamchid road (5.5 km) **Total 14.74 km**	Enkh Taivan avenue (8.7 km) Ikh Toiruu (3.55 km) Naadamchid road (3.0 km) **Total 15.25 km**
Maintenance (Pothole patching etc.)	For main road: Once in a year Enkh Taivan avenue (38.4 km) Chingis avenue (6.05 km) Naadamchid road (32.0 km) Ikh Toiruu (7.7 km) **Total 84.15 km**				
	Zaluuchid avenue (2.0 km) Khuvsgal road (2.2 km) Khukh Tenger street (0.95 km) Erkhuu street (0.7 km) Sukhbaatar street (1.34 km) Baga Toiruu (2.65 km) Ikh Surguuli street (1.44 km) **Total 11.28 km**	Uildverchinji Evlel street (0.65 km) Amarsanaa street (0.9 km) Gurvaljin road (1.2 km) Chingunjav street (0.95 km) Ajilchin street (3.2 km) Natsagdorj street (1.85 km) Tsagdaa street (1.6 km) Dandar Baatar street (0.92 km) Olymp street (4.1 km) Khatan Baatar Magsarjav street (0.52 km) Engels street (1.6 km) **Total 17.49 km**	Ard Ayush avenue (2.35 km) Khasbaatar street (2.3 km) Zaisan street (5.46 km) Doloon buudal road (6.5 km) Ring road for peace brg. (2.1 km) Khalaast road (4.07 km) Chingeltfi road (4.0 km) Dambadarjaa road (1.65 km) Dariekh-Dambadarjaa road (6.5 km) **Total 34.93 km**	Khuvsgal north road (7.5 km) S Danzan street (1.08 km) Ulaankhuaran road (0.6 km) 15th Khoroolol road (2.65 km) Zaisan Ikh Tenger road (2.18 km) Uildverchinji Evlel street (5.8 km) Sonsgolon road (7.62 km) Gachuurt road (2.8 km) **Total 30.23 km**	19th Khoroolol road (3.55 km) East Bayankhoshuu road (2.0 km) Zaluuchid avenue (2.0 km) Khuvsgal road (2.2 km) Khukh Tenger street (0.95 km) Erkhuu street (0.7 km) Tsagaan davaa road (2.7 km) Baga Toiruu (2.65 km) Ikh Surguuli street (1.44 km) Olymp street (4.1 km) Ajilchin street (3.2 km) Natsagdorj street (1.85 km) Tsagdaa street (1.6 km) Dandar Baatar street (0.92 km) Shar Khad road (3.4 km) **Total 33.26 km**

2) The Road Maintenance Plan

Two kinds of teams will carry out the road maintenance works: the road maintenance team will do crack repairing and pothole patching and the road improvement team will carry out re-carpeting and over-lay works.

i) Equipment

The list of equipment to be used by both teams is hereunder.

Table 2-3-33 Road Maintenance Team

Equipment	Main Spec.	Quantity	Purpose
Asphalt cutter	30 cm class	1	Cutting of asphalt concrete plate
Backhoe loader	100 hp class	1	Breaking and loading of asphalt concrete
Road maintenance truck	9 t - 11 t	1	Hauling of spoiled material and asphalt concrete, spraying of bitumen
Vibrating plate compactor	80 kg class	1	Compaction
Vibratory rammer	70 kg class	1	Compaction

Table 2-3-34 Road Improvement Team

Equipment	Main Spec.	Quantity	Purpose
Asphalt cutter	30 cm class	1	Cutting of asphalt concrete plate
Backhoe loader	100 hp class	1	Breaking and loading of asphalt concrete
Dump truck	4 t class	3	Hauling of spoiled material and asphalt concrete
Asphalt finisher	2.5 - 4 m	1	Asphalt concrete laying
Vibration roller (combined type) (One smooth drum, and 4 tires)	7 t class	2	Compaction
Line marker	15 cm	0.5*	Line marking

*: 1 unit for 2 teams

In addition, an asphalt plant to supply asphalt mixture for both teams is required.

ii) Productivity

It is extremely cold in Mongolia: therefore, it is very difficult to carryout the works in the winter, especially works of suitable quality. This is because of the hurried cooling of the asphalt mixture. Therefore, maintenance works will be carried out between the middle of May and the end of September.

Based on this circumstances, work volumes by team per year are hereunder calculated.

Table 2-3-35 Yearly Working Volume by One Team

Team	Equipment	Q'ty	Working Volume/day (m^2/day)	Working Day/year	Working Volume/year (m^2/year)
Road maintenance	Asphalt cutter	1	140	80	11,200
	Backhoe loader	1			
	Road maintenance truck	1			
	Vibrating plate compactor	1			
	Vibratory rammer	1			
Road improvement	Asphalt cutter	1	450	80	36,000
	Backhoe loader	1			
	Dump truck	3			
	Asphalt finisher	1			
	Vibration roller	2			
	Line marker	0.5			

iii) Number of Teams

Ulaanbaatar city assigns a portion of the maintenance works to the private sector. The remaining work volume is carried out by UBZZ. Number of teams required by UBZZ for carrying out the working volume per year is calculated based on this work volume as presented in Table 2-3-36.

Table 2-3-36 Required No. of Team

Team	Planned Working Area/year (m^2)	Working Volume/ year•team	Required No. of Teams
Road maintenance	49,200	11,200	4
Road improvement	54,000	36,000	2

Required volume of asphalt mixture is hereunder listed in Table 2-3-37.

Table 2-3-37 Required Volume of Asphalt Concrete

	Required Volume/year	Required Volume/hour (ton/hour)
Road maintenance	5,683	12.9
Road improvement	6,237	14.2
Total	11,920	27.1

* Thickness of asphalt concrete is 5 cm.

So, an asphalt plant of 30 ton per hour production capacity is required.

iv) Number of Teams and Equipment Required

The equipment required is calculated using the number of teams required to carryout the work volume and the performance of these teams. After the equipment required is calculated, it is reduced by the number of functioning equipment being held by UBZZ.

On the asphalt plant, the necessity of the supply was confirmed as the result of considering the following site situation.

a) There are three asphalt plants owned by two private companies located on the west side of Ulaanbaatar City. They are all Russian made, model DS1172k, and have a production capacity of 25 tons per hour. They were commissioned in 1983, 86 and 87. They are 12 - 16 years old and have exceeded their economical life periods. They are currently in operation; however, they are riddled with problems and are constantly breaking down. Repair time is quite long due to lack of spare parts. The above problems with the plants in conjunction with the short working season in Mongolia make it that the occurrence of any such problem will delay the project.
Moreover, the asphalt mixture is not sustainable due to the mixture ratio of the aggregate, filler and asphalt and problems with the heating control.

b) An asphalt plant implemented under the Japanese grant "The Project for Road Construction Utilizing Rock Asphalt in Mongolia" is located at Erdene Village, 76 kms east of Ulaanbaatar. It is not

recommended using the asphalt mixture of this plant for repairing the city roads. Because it takes 2 hours to transport the asphalt mixtures, it will cool down and loose its quality.

c) The Ulaanbaatar city wishes to establish an asphalt plant within the city limit in order to keep the supply source close at hand and to meet the scheduled road maintenance works. The city has already allotted the site, the personnel and the infrastructure for the smooth operation of the plant.

The candidate area for the plant is located in the industrial area, the western part, of the city and is close to the old plants. Therefore, its construction will not cause further environmental damages. The metropolitan government has further indicated that it will introduce extra inner railway lines making the plant easily accessible by railway. An asphalt-testing machine is required for the quality assurance of the asphalt mixture and is thus included with the asphalt plant.

Based on the above study, the equipment scheme for the Project is shown in Table 2-3-38.

Table 2-3-38 Equipment Scheme

No.	Equipment	Spec.	Requested Quantity	Required Quantity							UB ZZ Existing Equipment (B)	Planned Quantity (A) - (B)
				Maintenance and Improvement								
				Maintenance Team				Improvement Team		Total (A)		
				1	2	3	4	1	2			
1)	Asphalt plant	60 t/hr	1	1						1		1 (30 t/hr)
2)	Asphalt testing equipment		1	1						1		1
3)	Asphalt finisher	6.5 m	1									
4)	Asphalt finisher	2.5 - 4.0 m	2					1	1	2	1	1
5)	Vibration roller (combined)	7 t	3					2	2	4	4 Macadam roller 1 Tire roller 0 Vibration roller	2
6)	Backhoe loader	100 hp	9	1	1	1	1	1	1	6		6
7)	Small size dump truck	4 t	4					3	3	6	18	
8)	Line marker	15 cm	2					1		1		1
9)	Core drilling machine	15 cm	2					1		1		1
10)	Trailer	25 t	1	1						1	2	
11)	Mobile workshop	13 t	1									
12)	Double cab pickup	120 hp	2	2						2	1	
13)	Asphalt cutter	30 cm	8	1	1	1	1	1	1	6	2	4
14)	Vibrating plate compactor	80 kg	8	1	1	1	1			4		4
15)	Vibratory rammer	70 kg	8	1	1	1	1			4		4
16)	Road maintenance truck	9 - 11 t	6	1	1	1	1			4		4
17)	Universal truck	9 t	6									

(2) Basic Design

1) Equipment

The type, main specifications, quantities and purpose of the equipment to be procured under the Project are shown in Table 2-3-39.

Table 2-3-39 Equipment Scheme

No.	Equipment	Main spec.	Quantity	Purpose
1	Asphalt plant	Stationary Batch type Capacity more than 30 ton/hr	1	Production of asphalt concrete
2	Asphalt testing equipment	Marshall test apparatus Asphalt penetrometer Asphalt water bath etc.	1 set	Quality checking of asphalt concrete
3	Asphalt finisher	Paving width 2.5 - 4 m Canopy	1	Asphalt concrete laying For medium and small scale works
4	Vibration roller	Combined Operating weight more than 6,700 kg Canopy	2	Compaction of base course, pavement For medium and small scale works
5	Backhoe loader	Approx. 100 Hp Operating weight more than 7,500 kg Hydraulic breaker Cabin	6	Breaking of asphalt concrete, loading, excavation etc.
6	Line marker	Melted thermoplastic type Line width 15 cm Kneader Primer sprayer	1	Marking of center line, side line
7	Core drilling machine	Drilling dia. more than 15 cm Drilling depth more than 30 cm	1	Cutting of sample asphalt core for check
8	Asphalt cutter	Cutting depth more than 10 cm Blade dia. more than 30 cm	4	Cutting for parts of road repair section
9	Vibrating plate compactor	Weight approx. 80 kg Blade dia. more than 30 cm	4	Compaction of small scale work site
10	Vibratory rammer	Weight approx. 70 kg	4	Compaction of small scale work site
11	Road maintenance truck	Gross vehicle weight (GVW) 9 - 11 ton Equipment Dump Vessel 2 m^3 Asphalt tank 900 lit. Asphalt spray 50 lit./min. Air Compressor 2.5 m^3/min. Air breaker 30 kg Water tank 300 lit. Paving tools 1 set	4	For small scale road maintenance and repair works. Equip asphalt tank, sprayer, air compressor, breaker etc., base vehicle of road maintenance team.

2) Spare Parts

For the full utilization of the equipment spare parts are required, especially fast wearing parts and periodical maintenance parts and should be stored under the operating schedule of the equipment.

Normal road maintenance works cannot be carried out in the winter due to the extreme cold and snowfall. Therefore, the equipment will operate only 500 hours a year. Spare parts for two years of project period, 1,000 working hours, will be included with the mother equipment.

Cutter blade of the asphalt cutter and cutting bid of the core drilling machine are quick wearing parts and constitute a large percentage of the total cost. Therefore, their cost calculation will come under a different budget. The other required volume of spare parts for two years have been calculated based on the "Standard Japanese equipment cost estimation" and are shown in Table 2-3-40.

Table 2-3-40 Required Volume of Spare Parts

No.	Equipment	Standard Japanese Equipment Cost Estimation			Spare Parts for 2 years (%)	Special Consumable Parts (%)	Spare Parts Cost Total (%)
		Standard Durable Years	Repair and Maintenance Cost Ratio (%)	Repair and Maintenance Cost Ratio/year (%)			
1	Asphalt plant	8.9	55	6.2	6.2		6.2
2	Asphalt testing equipment						
3	Asphalt finisher	10.8	45	4.2	4.2		4.2
4	Vibration roller	10.6	40	3.8	3.8		3.8
5	Backhoe loader	6.9	40	5.8	5.8		5.8
6	Line marker	7.6	55	7.2	7.2		7.2
7	Core drilling machine	7.6	50	6.6	6.6	116.7	123.3
8	Asphalt cutter	6.0	45	7.5	7.5	116.5	124.0
9	Vibrating plate compactor	4.6	55	12.0	12.0		12.0
10	Vibratory rammer	4.6	50	10.9	10.9		10.9
11	Road maintenance truck	8.1	60	7.4	7.4		7.4

Chapter 3 Implementation Plan

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

The Project will comprise the following three components and they will be implemented in coordination with one another in each phase. The overall project implementation will be carried out over four fiscal years as envisaged below;

Fiscal year of Japan's grant aid	Major Components
First	Detailed Design Tendering for Procurement of Equipment
Second	Manufacturing of Equipment and Installation. Preparation works, Tendering and Improvement of Intersections
Third	Construction of Teeverchid Road
Fourth	Construction of Teeverchid Road

- The road construction works will be executed in 28 months in the following order:

  2nd year: Improvement of intersections with high occurrence of traffic accidents will be executed at first.

  3rd and 4th years: Widening of Teeverchid road (The length is 8.4 km).

- Specialists and technicians will be dispatched from Japan for the preparation of moulds for the production of bridge beams etc. which require a quality, execution of asphalt pavement with the use of equipment, assembling and operation of the asphalt plant and installation of road lightings and traffic signals.

- The works will be executed in a way not disturbing the present traffic function as much as possible.

(1) Teeverchid Road Widening

1) Road

- Teeverchid road with a length of 8.4 km will be improved during 3 years considering severe winter period (from November to March).

  3rd year: The east section of the road (the length is 4.8 km) with less obstacles will be improved at first. (Section between Piece Bridge and East End of Teeverchid Road)

4th year: The west section (the length is 3.6 km) will be improved. (Section between Piece Bridge and West End of Teeverchid Road)

- Widening work will be carried out, at first, on the part to be widened with the keeping traffic to flow through the existing road. After finishing of widening work, traffic will be shifted to the widened part and works for the improvement of the existing road will be started.

- With the wiening of one side of the existing road, traffic will, in principle, be coordinated to pass through the other side of the road.

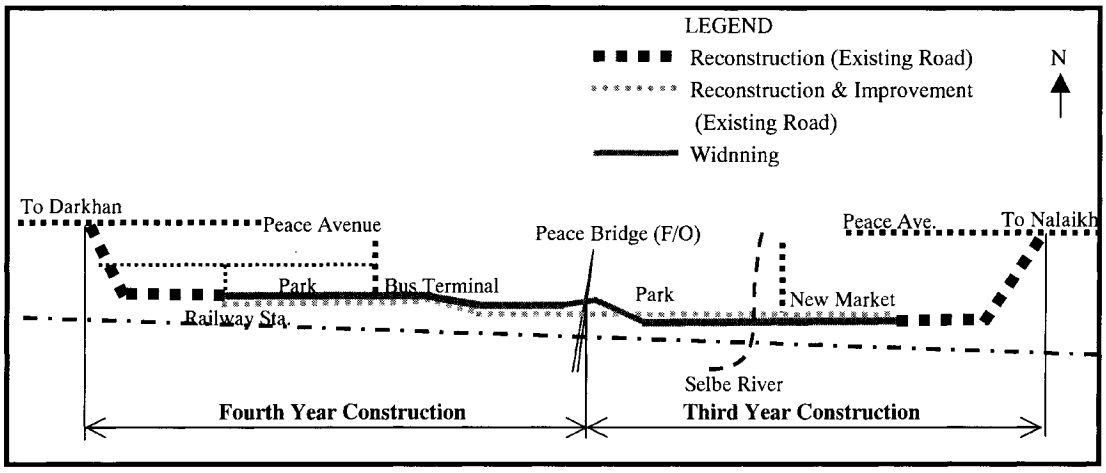


Fig.3-1-1 Construction Plan for Teeverchid Road

2) Bridge

Bridge construction will be carried out in the following sequence:

- Existing bridge will be kept and a new 2-lane bridge will be constructed on its south side.
- After completion of the new bridge construction, traffic will be shifted and the existing bridge will be removed.
- After removal of the existing bridge, a new 2-lane bridge will be constructed instead, on the same location.

i) Temporary Construction

Before starting the bridge construction works, a construction work yard with an embankment at a height of 1.5 m and a temporary road shall be

constructed on riverbank. Material from riverbank shall be used for construction of the work yard and a temporary road. During the above work, corrugated pipes shall be installed for passing of river water.

ii) Body Works

Main beam works will be carried out at the base camp yard. Temporary construction of main beams will be conducted with the use of crane.

(2) Three (3) Intersections Improvement (In front of Geser Temple, West Crossroad and East Crossroad)

Improvement of three intersections will be done in the second fiscal year. This work will require special attention to maintain traffic and pedestrian within limited space. Accordingly, it is so complicated that a piecemeal method of work will be applied and many manual works will be required to make full use of manpower instead of heavy equipment. If necessary, works will be carried out during the nighttime.

(3) Procurement of Equipment

Procurement of equipment will be implemented over two fiscal years as stipulated. Equipment will be utilized during the construction, and it will be transferred to the executing agency after the completion of construction.

3-1-2 Implementation Conditions

The main features of the Project are the improvement of existing road and intersections in urban area, with the technical challenge being a long cold period lasting from November to March (5 months) and full utilization of equipment to be supplied.

Matters to be taken into attention:

(1) Safety Measures

Since works will be, in principle, carried out without stopping of traffic, it is necessary to carry out a training programme for the staff on safety measures and to set up traffic coordinating (barrier, sign board, floodlight) and safety accessories at appropriate places in order to prevent accidents between workers, pedestrians, common vehicles and construction equipment.

(2) Influence of Climate

Temperature fluctuations are high even during the month of April - May and October, it is necessary to give enough attention to temperature keeping measures during pavement, concrete works, etc.

3-1-3 Scope of Works

In case of implementation of the project under the Japan's grant aid, expenses to be borne by the Japanese and Mongolian sides are as follows:

(1) Undertakings of Japanese Side

- Teeverchid Road widening and improvement works;
- Works for improvement of intersections (East Crossroads, West Crossroads and In front of Geser Temple);
- Dood Selbe Bridge construction;
- Demolish of existing bridge and pipe culverts near the bridge;
- Construction of detour and temporary roads and their removal;
- Construction of base camp and construction site and their removal;
- Supply and assembling of equipment;
- Supply of equipment and labor force required for the above construction works;

(2) Undertakings of Mongolian Side

- To relocate and to remove obstacles and underground facilities;
- To provide with land for construction and temporary construction works;
- To carry out necessary works for supply of electricity, water, communication etc. to the above-mentioned sites;

3-1-4 Consultant Supervision

(1) Basic Consept of Detailed Design, Tendering and Consultant Supervision

1) Detailed Design

The basic concept of detailed design is as follows:

- Field studies will be carried out and necessary data will be collected for the detailed design operational procedures, cost estimates in consultation, confirmation, and requirement of Mongolian side.

- After the completion of the design, the context of the detailed design will be explained to the Mongolian authorities, and discussions will be held.

2) Tendering

The basic concept of the Tendering will be as follows:

- Well qualified engineers will be employed to carry out the tendering operations as smoothly as possible.

3) Consultant Supervision

The basic concept of the construction supervision will be as follows:

- Well qualified engineers will be employed to carry out the construction supervision operations as smoothly as possible. Furthermore, it is necessary to adopt a backup support system for this project in Japan.

(2) Tendering

On behalf of the implementation agency of the Government of Mongolia, the Consultant will carry out the following activities related to tendering:

- Receiving of documents of qualification from bidders
- Examination of documents of qualification and preparation of a short list
- Opening of a briefing session to explain the works and answering to the questions
- Making a tender and examination and evaluation of bid proposals
- Opening of examination meeting, selection of successful bidder and giving a notice of award.

(3) Consultant Supervision

A supervisor will be required to perform the following construction supervision works.

- Approval of Construction Plans and Construction Drawings

  The supervisor will inspect the compliance of construction plans, construction schedules and work drawings, given by the Contractor, to the contract, construction drawings and specifications and improve them.

- Schedule Management

  To receive reports on construction progress from the Contractor and give instructions to ensure completion of works within the given time schedule.

- Quality Inspection

  Inspection of quality of construction and/or construction materials for their compliance with the specifications and the drawings of the contract documents and their approval.

- Measurement Inspection

  Inspection of whether or not the finished size satisfies the control standards upon inspection of completed sections and horizontal shapes, etc., while confirming the specifications.

- Issuing of Certificates

  Issuance of certificates at interim payments, on completion, at the end of warranty period, etc. for contractors.

- Submission of Reports

  Inspection of monthly construction reports, as-built drawings and completion photographs submitted by contractors, and their submission to the Mongolian government and JICA, etc. Also, he will compile an overall report according to compilation policy for grant aid projects after completion of construction works and will submit to JICA.

(4) Consultant Supervision System

The number of Japanese engineers to work as construction supervisors and their period of stay are shown below, according to schedule and content of construction. Also, local staff will be employed for the purpose of technical transfer.

- Team Leader

  The Team Leader will be sent to the site during the commencement and completion of main construction works.

- Resident Engineer

  The Resident Engineer will stay on the site throughout the entire construction period and supervise all areas of construction works.

- Bridge Engineer

  The Bridge Engineer will be sent to the site, when necessary, during the bridge construction period and supervise the works for construction of upper and lower parts of the bridge and concrete structure works.

- Equipment Engineer

  The equipment engineer will be sent to the site for brought - in inspection of equipment, asphalt plant mounting inspection, during the start of use and hand-over of supplied equipment.

3-1-5 Procurement Plan

(1) Materials and Equipment for Construction

1) Basic Concept

Those materials and equipment necessary for construction works that are readily available in Mongolia, will be used as much as possible. However, if there are some problems related to quality or quantity of existing materials and equipment and, also, it is difficult to procure them in time, then the necessary materials and equipment will be imported from third countries or Japan.

2) Materials Supply Condition

A survey on the availability of construction materials in the Mongolian market reveals that all materials except cement, reinforcing bars, aggregates and wooden materials are mainly imported, and the status quo shall be considered for this Project too.

i) Cement

Ordinary Portland cement is available from the cement plant in Darkhan.

ii) Reinforcing Bars

Reinforcing bars are also available from metallurgical plant located in Darkhan. Size of their products vary from D10 to D29.

iii) Straight Asphalt

Straight asphalt is usually imported from Russia and is generally available in Mongolia.

iv) Crushed Stone and Aggregates

Aggregates and crushed stones are available near Ulaanbaatar. There are several quarries located near Ulaanbaatar with license issued by the Environment Department of Ulaanbaatar. Materials required for the construction works are available from the following quarries:

Material	Name of Quarry	Location	Quality	Area of Quarry
Embankment material	Khukh Tolgoi	10 km from the beginning point of Teeverchid road.	CBR = 16	112 ha
Lower sub-base material	Tsaiz	3.5 km from the end point of Teeverchid road	Crusher-run Modified CBR = 69	25 ha
Upper sub-base material	Sonsgolon	9.5 km from the beginning point of Teeverchid road	Grade adjusted material Modified CBR = 142	1,000 ha

v) Ready Mixed Concrete

Ready mixed concrete is available from four concrete plants located in Ulaanbaatar City with the capacity of 50 - 120 m^3 of concrete per day. But the strength of their produced concrete is defined by rectangular parallelepiped sample, which is different from the Japanese JIS standard (JIS A 1108: cylinder sample).

Mongolian standard	M-150	M-200	M-250	M-300	M-350
Correlating JIS standard	107 kg/cm^2	148 kg/cm^2	190 kg/cm^2	232 kg/cm^2	273 kg/cm^2

vi) Concrete Secondary Products

Above-mentioned concrete plants produce few types of concrete secondary products. Products not produced in Mongolia such as U-channel, L-type channel, centrifuge reinforced concrete pipe and gully shall be manufactured at the concrete plant of the base camp.

vii) Traffic Signal

Traffic signals existing in Ulaanbaatar are produced in Russia and their operation requires frequent maintenance due to breakage and burning out of lamps. In June 2000, JICS project has been started to change traffic signals by Korean ones on 12 important intersections under the Japan's grant aid program. Traffic signals will be supplied with the consideration of the availability of spare parts from third country including Korea.

viii) Lighting

Presently used lighting materials, same as traffic signals, are produced in Russia. Japanese lighting materials are used at Zamyn-Uud station even now. (The lighting materials supplied to the railway transshipment facility in Zamyn-Uud under the Japanese grant aid in 1993 - 1995 were able to withstand severe climate conditions. Therefore, lighting facilities will be supplied from Japan.

ix) Materials to be Used for Bridge Construction

Materials for shoe, anchor bar, expansion joint, etc. to be used in the bridge construction can not be manufactured in Mongolia, but is possible to procure them from third countries like Russia or China. The abovementioned materials are unavailable in local markets, as there is no domestic demand for these materials. Therefore, these materials will be supplied from Japan.

3) Procurement Plan of Materials

Considering the present procurement conditions mentioned above, the procurement plan of major construction materials is shown in Table 3-1-1.

Table 3-1-1 Procurement Plan for the Major Construction Materials

Name of Material	Specification	Supply Source			Remarks
		Mongolia	Japan	Third Country	
Embankment Materials		○			Existing quarry site
Base course material	Graded crushed stone	○			Existing quarry site
Subbase material	Crusher-run	○			Existing quarry site
Straight Asphalt		○			Imports
Pavement aggregate	Crushed stone and sand	○			
Road marking paint			○		
Cement	Portland	○			
Fine aggregate	Sand	○			
Coarse aggregate	Crushed stone	○			
Ready mixed concrete		○			Existing plant
Plywood		○			Imports
Steel form		○			Imports
Reinforcing bar	Deformed bar	○			
Shoe	Rubber		○		
Expansion joints			○		
Aluminum handrail (bridge)			○		
Road lighting			○		
Guard rail			○		
Traffic signal				○	
Curbstone		○			
Concrete pipe		○			Produce on site
Timber		○			
Staging material		○			Imports
Fuel		○			Imports

(2) Procured Equipment

Implementation plan for procurement from Japan and the third countries is detailed hereunder. No suitable equipment is available in Mongolia for the project; therefore, nothing will be procured in Mongolia.

1) Japanese Goods

The implementing and executing agency of the Mongolian Government wishes to introduce Japanese goods due to the excellent performance of the equipment procured under the "Project for Road Construction Utilizing Rock Asphalt", availability of distributors (after service agents) and the acceptable performance of supporting activities.

Based on these circumstances, Japan was recommended as the country of procurement.

2) Goods from third countries

There are no manufacturers of backhoe loaders in Japan. Therefore, it will be procured from a third country such as U.S., U.K., Italy, etc. It will be procured from the manufacturer with an established service agent in Mongolia and whose equipment is of good acceptable quality.

Ratio of procured equipment: Japan 81 %
The third countries 19 %

Table 3-1-2 Eligible Source Country

No.	Equipment	Japan	Third Countries	Mongolia	Reason
1	Asphalt plant	○			In view of quality and after service
2	Asphalt testing equipment	○			In view of quality and after service
3	Asphalt finisher	○			In view of quality and after service
4	Vibration roller	○			In view of quality and after service
5	Backhoe loader		○		USA, UK, Italy products have reputation and have after service facility
6	Line marker	○			In view of quality and after service
7	Core drilling machine	○			In view of quality and after service
8	Asphalt cutter	○			In view of quality and after service
9	Vibrating plate compactor	○			In view of quality and after service
10	Vibratory rammer	○			In view of quality and after service
11	Road maintenance truck	○			In view of quality and after service

3-1-6 Implementation Schedule

(1) Flow of Implementation Schedule

The flow of works after carrying out of Exchange of Notes till the completion of the Project is largely divided under following headings. Implementation schedule is shown in Fig. 3-1-2:

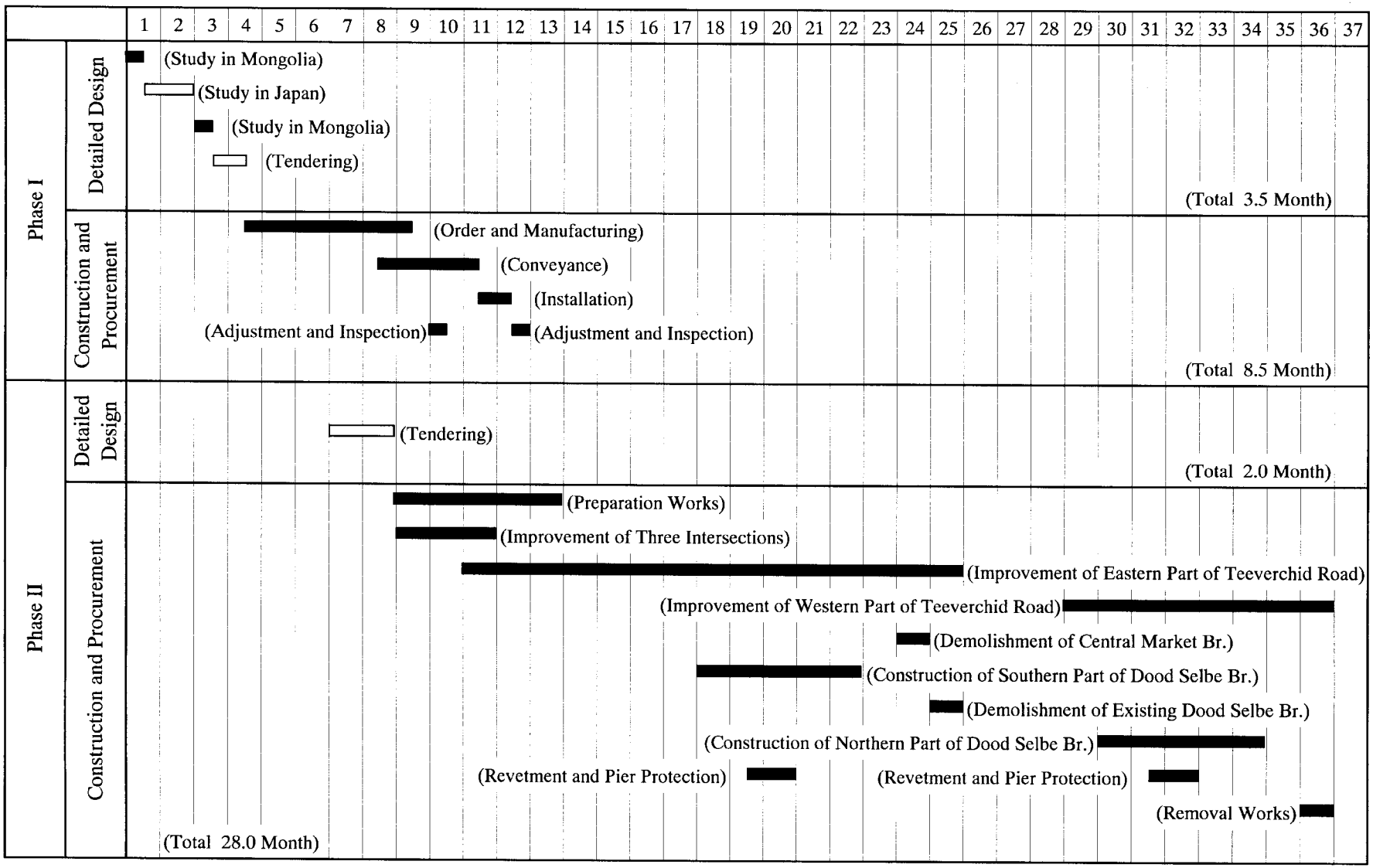


Fig. 3-1-2 Implementation Schedule

3-1-7 Obligations of Recipient Country

- To secure the safety of the implementation works
- To publish of permission necessary for implementation of the project
- To pay and form Banking Arrangement with Japanese Bank
- To publish of Authorization to Payment for the project
- To supply electricity, water, communication etc., to above mentioned site
- To exempt from custom taxes and to ensure prompt custom clearance of the equipment to supplied
- To exempt Japanese and the 3rd countries specialists necessary for implementation of the project from the payment of custom taxes and other fiscal levies which may be imposed in Mongolia
- To approve Japanese and the 3rd countries specialists necessary for implementation of the project from the immigration and the residence
- To bear all expenses which are out of the scope of Japan's grant aid
- To maintain and utilize in a proper and effective manner the road constructed and equipment supplied under the Japan's grant aid
- To relocate and to remove obstacles and underground facilities
- To provide with land for construction and temporary construction work
- To carry out necessary works for supply of electricity, water, communication etc. to the above-mentioned sites

3-2 Operation and Maintenance Plan

(1) Road facilities

1) Operation and Maintenance System

If a operation and maintenance method mentioned in 2) below is maintained, then the road facilities and the bridge constructed under the Project could last for 5 to 10 years and 20 to 30 years respectively without overhaul after the completion.

However, the maintenance of facilities after the completion of the Project depends, also, on the performance of existing maintenance system, namely, on the Capital Investment & City Amenities Department of Ulaanbaatar City Government.

2) Operation and Maintenance Method

Table 3-2-1 Inspection List for Maintenance

	Inspection Items	Maintenance/Repair	Time Interval of Inspection
Road	① Pavement	Repair with bitumen of cracks due to low temperature	every spring
		Pot hole repair	every spring & autumn
	② Lighting	Checking of lamps and damages on poles	every month
Bridge	① Upper part	Inspection and repair of cracks, etc.	every spring
	② Lower part	Inspection and repair of cracks, etc.	every spring
	③ Bearing	Cleaning of accumulated sand and dust	every 3 months
	④ Expansion joint	Replacement of dropped out seal gums	every 3 months
	⑤ Handrail	Repair of damages due collision of vehicles, etc.	every 3 months
	⑥ Protection of river floor	Inspection and repair of washing-offs	every year

The inspections mentioned above will be carried out by the road maintenance company included in the organization chart of the Ulaanbaatar City Government.

To carry out regular maintenance, it is important to record the results of inspections to define the time for future repairs and for their execution. For that purpose, it is necessary to establish a system for regular inspections from the very beginning.

3) Operation and Maintenance Cost

It is necessary to take, in average, a maintenance cost as 2 % and 5 % of the construction cost for the periods after 5 years and after 5 to 10 years of the completion of works respectively.

The operation and maintenance cost in 2003 will be of about 4.6% of the Ulaanbaatar city road budget for 2000 which is good enough to be allocated.

Table 3-2-2 Maintenance Cost Estimation

(million togrogs)

Years			2003	2004	2005	2006
Intersection improvement	Electricity		2.0	2.3	2.5	2.9
	Maintenance		1.7	1.7	1.7	1.7
Teeverchid road improvement	Electricity		16.5	18.2	20.0	21.6
	Maintenance	Road	32.1	32.1	32.1	32.1
		Bridge	3.5	3.5	3.5	3.5
Total			55.8	57.8	59.8	61.8

(2) Procured Equipment

1) Maintenance Procedure

Equipment to be procured will be utilized and maintained by UBZZ under the municipality of Ulaanbaatar after the completion of the scheduled works.

2) Operating and Maintenance Cost

Operating and maintenance cost of the equipment such as fuel, oil and electricity, and repair and maintenance cost are calculated and presented in Tables 3-2-3 and 4.

Table 3-2-3 Fuel, Oil Electricity Cost Estimation

No.	Equipment	Spec.	Quantity	Fuel, Oil Electricity Cost (Tg/Unit•Hour)	Total Fuel Cost '000 Tg/ Total Unit·Year
1	Asphalt plant	107 kW	1	Electricity 107 kW × 40 Heavy Oil100 lit. × 302 kg } = 34,480	17,240
2	Asphalt testing equipment	-	1	-	-
3	Asphalt finisher	50 Hp	1	0.155 × 50 × 1.01 × 604 = 4,728	2,364
4	Vibration roller	100 Hp	2	0.155 × 100 × 1.01 × 604 = 9,456	9,456
5	Backhoe loader	100 Hp	6	0.188 × 100 × 1.01 × 604 = 11,469	34,407
6	Line marker	3.5 Hp	1	0.310 × 3.5 × 1.01 × 626 = 686	343
7	Core drilling machine	3 Hp	1	0.310 × 3 × 1.01 × 626 = 588	294
8	Asphalt cutter	5 Hp	4	0.310 × 5 × 1.01 × 626 = 980	1,960
9	Vibrating plate compactor	5 Hp	4	0.310 × 5 × 1.01 × 626 = 980	1,960
10	Vibratory rammer	3.5 Hp	4	0.310 × 3.5 × 1.01 × 626 = 686	1,372
11	Road maintenance truck	190 Hp	4	0.054 × 190 × 1.01 × 604 = 6,259	12,518
Total			25		81,914

Condition

1. Unit price

Gasoline	626 Tg/lit.
Diesel	604 Tg/lit.
Heavy oil	302 Tg/lit.
Electricity	40 Tg/kWh

2. Working hour/year 500 h
3. Fuel consumption ratio lit/unit·hour
Standard Japanese equipment cost estimation
4. Oil cost 1 % of fuel cost

Table 3-2-4 Repair and Maintenance Cost Estimation

No.	Equipment	Main Spec.	Quantity	Repair and Maintenance Cost Ratio % / Unit•Year	Repair and Maintenance Cost '000 Tg/Total Unit•Year
1	Asphalt plant	107 kW	1	33 / 8.9 = 3.7	27,908
2	Asphalt testing equipment	-	1	-	-
3	Asphalt finisher	50 Hp	1	27 / 10.8 = 2.5	4,621
4	Vibration roller	100 Hp	2	24 / 10.6 = 2.3	5,045
5	Backhoe loader	100 Hp	6	24 / 6.9 = 3.5	16,265
6	Line marker	3.5 Hp	1	33 / 7.6 = 4.3	2,092
7	Core drilling machine	3 Hp	1	30 / 7.6 = 3.9	262
8	Asphalt cutter	5 Hp	4	27 / 6.0 = 4.5	368
9	Vibrating plate compactor	5 Hp	4	33 / 4.6 = 7.2	381
10	Vibratory rammer	3.5 Hp	4	30 / 4.6 = 6.5	531
11	Road maintenance truck	190 Hp	4	36 / 8.1 = 4.4	21,992
Total			25		79,465

Assumptions

1. Repair and maintenance cost ratio — In consideration of Mongolian labor cost, it has been applied 60 % of "Standard Japanese equipment cost estimation".

2. Durable years — In consideration of Mngolian short working hours in a year, (only in summer season) and durable years of existing equipment, equipment durable years should be double of "Standard Japanese equipment estimation". In this case, repair and maintenance cost ratio of life also should be double, hence, in this calculation, we use same durable years with "Standard Japanese equipment estimation".

3. Equipment cost — Equipment cost estimation CIP Ulaanbaatar
Exchange rate 1 Tg = 0.0993 Yen

Chapter 4 Project Evaluation and Recommendations

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATIONS

4-1 Technical Feasibility and Benefits

The Project is located in Ulaanbaatar City and comprises the improvement of Teeverchid Road, three intersections of East Crossroads, West Crossroads and In front of Geser Temple and purchase of road maintenance equipment.

8.4 km long Teeverchid Road is located in the built-up area and runs parallel to Enkhtaivan Avenue and railway, which is the only one east-westward route available for large trucks to pass through. This road is designated as a part of Asian Highway No. 3 in Ulaanbaatar City. Car ownership increases rapidly as the economic activities are accelerated and the population increases in the city after the transition to market-oriented economy since 1990. However, roads were deteriorated and road development lagged behind because of insufficient maintenance due to the shortage of budget and severe conditions against pavement structure due to repeating action of freezing and thawing by heavy vehicles. Accordingly socio-economic activities are affected considerably under such circumstances.

The objective of the Project is to improve road transportation networks in Ulaanbaatar City in order to contribute for economic development and enhance social services. Direct and indirect benefits brought by the Project are summarized as follows.

(1) Direct Benefits

1) Increase of Traffic Capacity and Enhancement of Traffic Safety

Three intersections of East Crossroads, West Crossroads and In front of Geser Temple have enough high volume of traffic in Ulaanbaatar City and simultaneously have high rates of traffic accidents. The existing traffic except both ends of Teeverchid Road exceeds undivided 2-lane traffic capacity largely and the existing pavement in a whole stretch is so deteriorated that traffic safety is hardly secured.

The Project will be able to improve such traffic situation drastically to increase traffic capacity as well as to enhance traffic safety.

2) Rehabilitation of Road Function against Heavy Vehicles

East-westward heavy traffic is controlled to bypass Enkhtaivan Avenue toward Teeverchid Road. Although it is designated as a part of Asian Highway No. 3 in Ulaanbaatar City, the pavement and bridge structure are not designed to comply with heavy vehicles. Accordingly, it cannot fulfill its expected roles and functions.

The Project will enable to rehabilitate Teeverchid Road as a designated major arterial road.

3) Savings of Transport Costs due to Road Improvement

The Project will alleviate traffic congestion at three major intersections in Ulaanbaatar City and will improve traffic situation on Teeverchid Road, especially for heavy vehicles. Smooth traffic flow will result in avoiding waste of time and fuel and practicing more economical transportation as well.

It is expected that such improvement will yield considerable benefits in terms of transport cost savings.

4) Improvement of Road Maintenance Capability

The Ulaanbaatar City Government is responsible for road construction and maintenance in the city. However, road maintenance has lagged behind because of insufficient budget and the shortage of maintenance equipment. The road maintenance capability of the City remains very low due to recently rapid increase of vehicles, obsolete maintenance equipment, low level of road construction standard and severe weather condition.

The Project will be able to make the capability of road maintenance improved.

(2) Indirect Benefits

1) Enhancement of Regional Economic Activities by the Project

The Project will relieve traffic bottlenecks and will restore detouring traffic by the improvement of road and intersections. It is anticipated that it may contribute to enhance regional economic activities.

2) Improvement of Environment

The Project will make the living environment along road better due to relief of traffic congestion and decrease of suspending particles. Furthermore, well-designed drainage system will be able to improve present situation such as puddles and unevenness brought by few drainage.

3) A Model Practice of Road Improvement

There exist a few roads with drainage, sidewalk and street lighting in Ulaanbaatar and no channelized intersection. Road incidental works were not be given priority and citizen did not pay attention to their effectiveness. The Project will exhibit a model practice of urban street equipped with necessary incidental works such as drainage, sidewalk, street lighting and traffic signal to the public and will show its effectiveness.

It is expected that the improvement of Teeverchid Road and three intersections will become symbolic model practices in Ulaanbaatar.

4-2 Technical Cooperation and Coordination with Other Donor

Road construction projects in Mongolia fully depend upon bilateral or multi-lateral assistances such as the World Bank, Asian Development Bank, Kuwait and Japan.

Rapid increase of vehicular traffic after the transition to market-oriented economy requires the rehabilitation and improvement of roads and bridges that are deteriorated by low level of road construction standard and severe weather condition.

It is significant that the Project will be implemented in coordination with other regional arterial road projects.

It will be possible to implement the Project without any relevant technical cooperation if the Project team keep close relationship with Ministry of Infrastructure as the responsible agency and Ulaanbaatar City as the executing agency from the detailed design to construction supervision in addition to coordinating with those who are related to other road projects.

4-3 Conclusion and Recommendations

The Project aims to improve road transportation networks in Ulaanbaatar City in order to contribute to facilitate economic development and enhance social services impaired after the transition to market-oriented economy. Considerable benefits enumerated in this chapter are expected to be brought by the Project and it is also anticipated that the Project may contribute to enhance regional economic activities, especially in Ulaanbaatar and its surroundings.

Accordingly, the implementation of the Project is deemed appropriate under Japan's Grant Aid System.

It is important that a periodic inspection should be carried out and some damages such as cracks, potholes and so forth should be repaired immediately once found, considering the importance of timely road maintenance. Accordingly, it is recommended that a road inspection system should be planned from an initial stage and the basic information and data including a road inventory and future maintenance program should be compiled.