4) City Drainage

The drainage system in the city is divided into two routes, shown in Fig. 2-3-11. One is the drainage channel which receives run-off water from northern part of hilly area and the other that receives from southern down hill part. The northern drainage channel is made of concrete and it drains into Dundgol River. The channel capacity is not sufficient to allow smooth water flow, as a result overflows and flows down to the sorthern part of the drainage area occurs during flood periods. Most of the roads except a part of trunk roads in the southern part drainage area have no drainage channels. Under this condition, even with the existence of pipe or open channel drainage, the present drainage facilities are not functioning well due to clogging of garbage and sandy materials. In order to improve this condition the city authority has been formulating an action plan for Improvement of city drainage discharge into Selbe River.

Teeverchid Road is located on the foot hills in the north and on the railway embankment in the south. As a result, water stagnation occurs during the rainy season as drainage facilities rarely set on Teeverchid Road. Flood induced damages mainly hit the western part of Teeverchid Road, because of its relatively lower height.

In East Crossroads Intersection, drainage facilities are set on Ikh Truu Road parallel, and the maintenance is also carried out. Though, rainfall is accumulated on the intersection after rain, due to drainage facilities on Ikh Truu Road are inadequate.

In West Crossroads Intersection, drainage facilities are set on along Enkhtayvan Avenue, and the maintenance is also carries out. On the other hand, drainage facilities are inadequate along Ikh Truu Road. Though, rainfall is not accumulated on the intersection after rain, due to longitudinal slope has been given along Ikh Truu Road. However, the rainfall, which gathered from the circumference, flows the road. And, the road becomes the drainage. As the result, it becomes the disturbance of the smooth travel.

In front of Geser Temple Intersection, drainage facilities are inadequate. Though, rainfall is not accumulated on the intersection after rain, due to longitudinal slope has been given along Ikh Truu Road. However, the rainfall, which gathered from the circumference, flows the road. And, the road becomes the drainage. As the result, it becomes the disturbance of the smooth travel.

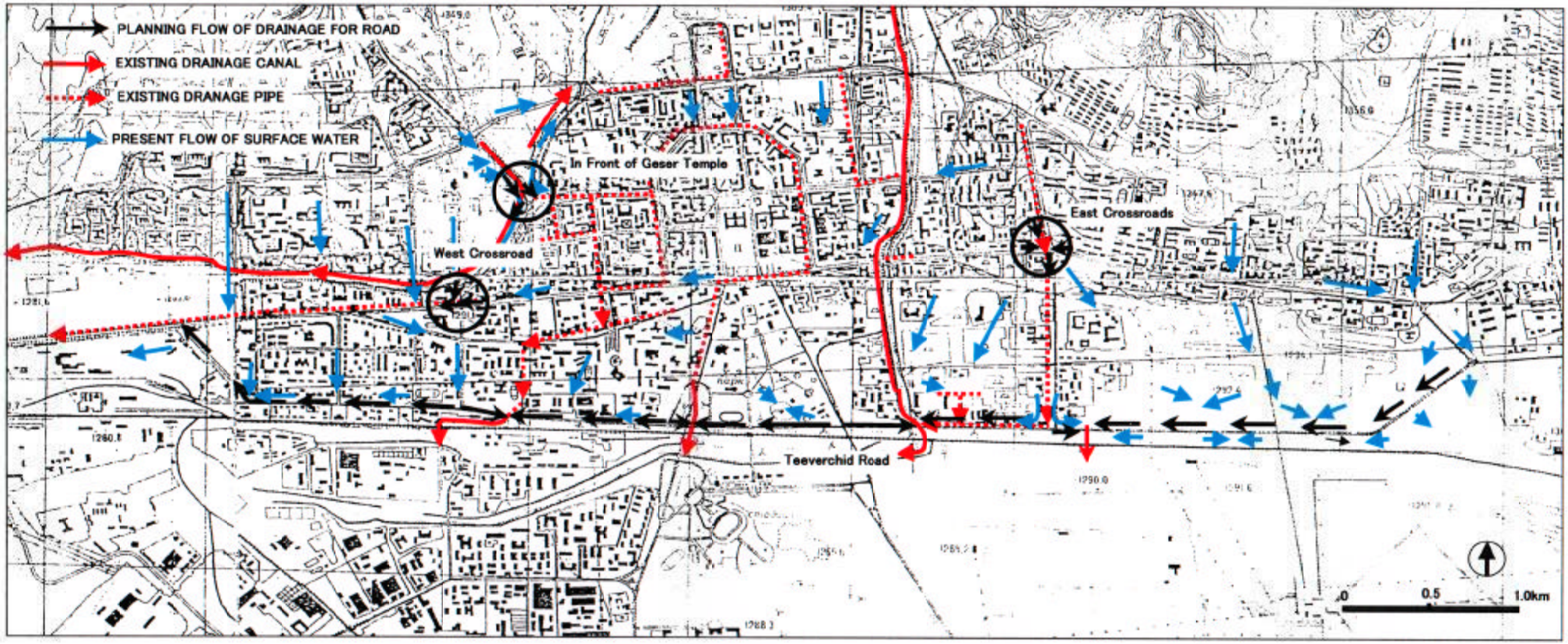


Fig. 2-3-11 Existing Drainage Facilities in Ulaanbaatar

(5) Bridge

1) Conditions of Existing Bridges on Teeverchid Road

In total, 32 bridges are located on the primary, regional, city and other special roads in Ulaanbaatar City, facilitating the traffic movement.

The types of bridges are almost reinforced concrete T-shape girder except three prestressed concrete T-shape girder, constructed from the viewpoint of easier supply of materials and construction method. However, there is no steel bridges in Ulaanbaatar City, since it is difficult to import the steel material and the quality of materials get worsen in the extremely cold environment.

These bridges were constructed between 1960 to 1990. Moreover, many of these bridges were constructed by Russian and China contractors during 1960s.

In comparison with the as-built drawings and standards, the actual width of main girder (16 to 17 cm) and thickness of slab (10 to 15 cm) are shortened. Consequently, the stability of bridge in terms of rigidity, durability and loading capacity is not upto the limit due to large and heavy vehicles movement.

The bearing layers under substructure are of hard gravel (N-value: more than 30) in area of Ulaanbaatar City, and these substructures are not settled yet. The construction quality and method were not up to the standard. The revetment and embankment at the river sections were scoured, destroyed or damaged due to floods.

There are two bridges in the Project Area, one across Selbe river and another at the Southern part of new market, both on Teeverchid road. The dimensions of the bridges are shown as below in Table 2-3-6.

Table 2-3-6 Dimensions of the Project Bridges

Name		Dood Selbe Bridge (Selbe river)	14th Khoroolol Bridge (South side of New market)
Station No.		5k846 m	6k815 m
Dimension	Bridge length	4@11.4 m = 45.6 m	11.4 m
	Width	Carriage 7m+Side walk 2 @1 m = 9 m	Carriage 7 m + Side walk 2 @1m = 9m
Type	Super str.	Simple RC-T girder	Simple RC-T girder
	Sub str.	RC Reversed T abutment RC Cylindrical column pier	RC Reversed T abutment
	Foundation	Spread	Spread
Constructed year (Contractor)		1963 (China)	1963 (China)
Applied Standard		Russian	Russian
River Condition, Others		Selbe river width 40 to 50 m	No river at upstream due to embank for market parking

The locations of the Project bridges and main bridges in Ulaanbaatar City are shown in Fig. 2-3-12.

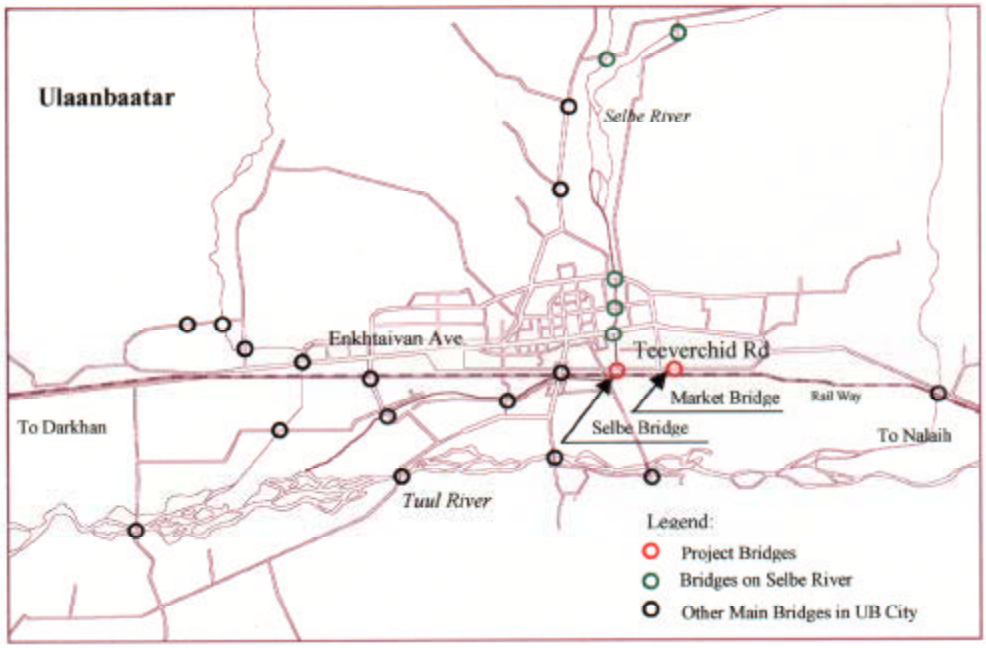


Fig. 2-3-12 Project Bridges and Main Bridges in Ulaanbaatar City

The existing bridges on Teeverchid road have no durability of structures because of overage (37 years after construction), and heavy vehicle and high traffic volume. Especially, the surface of bridges and roads is heavily damaged and destructed due to increased traffic volume and heavier vehicles. Therefore, structural stability and durability of the bridges are shortened.

2) Soundness Survey of Bridges

The method of soundness survey included the following two items for this project. The project bridges were evaluated on above items A and B in consideration of the loading capacity corresponding to widening of Teeverchid road, design river section and traffic volume.

A- Soundness evaluation by site inspection and data collection of the existing bridge

B- Checking structural calculation of existing bridge

A. Soundness Survey

The results of overall soundness of the two project bridges are rated with points as detailed in the following Table 2-3-7. The method of bridge evaluation of the item A are shown in Table 2-3-8.

Based on the above soundness survey, it can be judged that both bridges require urgent repair, improvement or replacement.

Table 2-3-7 Evaluation Rating for Bridge Soundness

Evaluation Item		Name of Bridge	
		Dood Selbe	14th Khoroolol
Durability	Super Str. Damage	1.8	1.8
	Sub Str. Damage	1.2	1.2
Loading	Heavy Traffic	0.6	0.6
Function	Constructed Year	0.3	0.3
	Width, Flood	0.6	0.2
Rating Result	D : 1.5 - 2.5		
	C : 2.5 - 3.5		
	B : 3.5 - 4.5		4.1
	A : 4.5 - 5.5	4.5	
Overall Evaluation		A	B

Table 2-3-8 Overall Evaluation of Bridge Soundness for Item A

Bridge Conditions	Rating	Evaluation
Survey results showed no damages and defects. And, bridge has functional stability.	1	D
Damage has been detected and a follow-up survey is required. And, bridge has functional stability at present.	2	C
There are significant damages / defects. Therefore, a detailed survey is needed and the necessity of repair work including function of bridge should be considered.	3	B
There are significant damages / defectes, and no function. Therefore, urgent repair is required. The bridge has to be closed for traffic or restriction on vehicle weight to be imposed. (or re-construction of bridge)	4	A

B. Check of Structural Calculation of Existing Bridge

With regard to the stability of super and sub-structures, the calculations were made taking into account the causes of the damage and destruction. The super and sub structures were judged on the capacity of load according to calculation of strength.

The type and damaged conditions of both Dood Selbe and Khoroolol bridge are similar. Therefore, Dood Selbe bridge was checked out for the stability as mentioned below.

i) Super Structure

Design standard for the bridge shall be applied as TL-25 [B-Live Load] in accordance with Japanese Specification in the world use of heavy loading method and discussion with Mongolian Government.

Present design methods for live loading uses the Russian Standards.

As shown in Fig. 2-3-13, which compares loading system between Mongolian and Japanese [B-live loading system], Mongolian live load system is lower than Japanese live loading system.

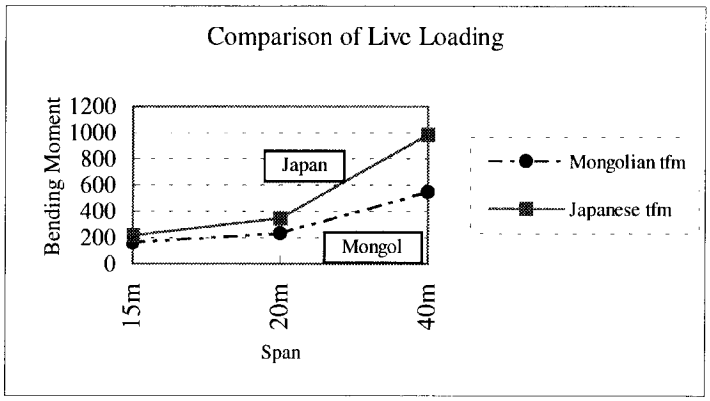


Fig. 2-3-13 Comparison of live Load using Mongolian and Japanese Methods

Therefore, the strength of existing superstructure was calculated by Japanese B-live load. The results of strength are listed as presented in Table 2-3-9.

As the below calculation results show, the strengths of concrete and reinforcing bar for slab and girder extremely exceeded the allowable strengths.

The existing girders were damaged as reflected in occurrence of shearing crack and bending crack due to vertical force. These cracks occurred in relation to exceeded external force.

Therefore, it is difficult to re-utilize, widen and reinforce the existing bridges for the reasons of overage of concrete (37 years have passed after construction) and fatal cracks.

Table 2-3-9 Results of Strength for the Superstructure

Application	Slab (thick 12.5 cm, Re-bar Φ16 mm 20 ctc)	Girder (H 84.5cm、Re-bar Φ28-6, Φ16-2)
B-Live Load (Japan)	M = 1.85 tm Concrete strength $\sigma c = 147$ kg/cm^2 >Allowable strength $\sigma ca = 60$ kg/cm^2 ($\sigma ck = 180$ kg/cm^2) Steel bar strength $\sigma s = 3257$ kg/cm^2 >Allowable strength $\sigma sa = 1400$ kg/cm^2 (Yield strength 2400 kg/cm^2)	M=54.8 tm Concrete strength $\sigma c = 58$kg.cm^2 <Allowable strength $\sigma ca = 60$ kg/cm^2 ($\sigma ck = 180$ kg/cm^2) Steel bar strength $\sigma s = 2022$ kg/cm^2 >allowable strength $\sigma sa = 1400$ kg/cm^2 (Yield strength 2400 kg/cm^2)

ii) Sub Structure

The existing shoe beds which are hit by the impacts due to defective pavement surface have no shoe pad at any parts. This reduces the resistance area of bearing strength and shearing force, and concentration of strength takes places, which has profound effect on the sub-structure.

As mentioned above, the shoe beds of all parts were either cracked or destructed and broken down; exposed reinforcing bars are widely seen; particularly, width of shoe beds are less than the optimum design width.

The above damages occurred because, the allowable capacity of shearing resistant force for shoe beds exceeded the external working force, which includes girder weight and load impacts.

These results of shear force calculations at shoe bed are shown in Table 2-3-10.

Also, existing substructures are difficult to widen and reinforce from the view points of overage of concrete (37 years has passed after construction) and wide occurrence of fatal cracks at strategic points.

Table 2-3-10 Results of Shearing Force for Shoe Bed

Item	Working force/strength	Allowable capacity	Judgement
Force	Working force = 6.1 ton	Resistant force = 3.5 ton	Not Workable
Strength	Punching shear = 9.6 kg/cm^2	Punching shear = 8.0 kg/cm^2	Not Workable

Furthermore, the existing substructures, abutment and pier, were examined for their stability as shown in the following Table 2-3-11.

Table 2-3-11 Results of Stability Analysis for Substructures

B-Live Load (Japan)	Stability		
	Overturn	Slide	Bearing
Abutment (Normal case)	0.66 < 0.68	0.90 < 1.5 over (Earthquake) 1.0 < 1.2 over	21 < 30
Pier (Earthquake case)	0.37 < 0.87	4.54 > 1.2	18.4

As can be seen from the above table, the substructures are not stable against overturn and sliding forces.

(6) Selbe River

1) Catchment Area and River

The Selbe River is running through the eastern part of city from north to south and is the only river directly related to the Road Improvement Project in the study area.

The Selbe River has a catchment area of 296 km^2, which is composed of housing area in down stream and some forestry areas in upper stream. The hilly mountains with gentle slope consist of high permeability weathered rock and sandy materials. The Selbe River is about 38 km long from the upper summit to down stream of the Road Project site. About 3.5-km reaches in the city section composed both an earthen embankment and concrete revetment with 35 to 40 m-river width. The upper river reach is a flood prone area with sediment deposit and has wider river sections varying from 700 m to 1,000 m.

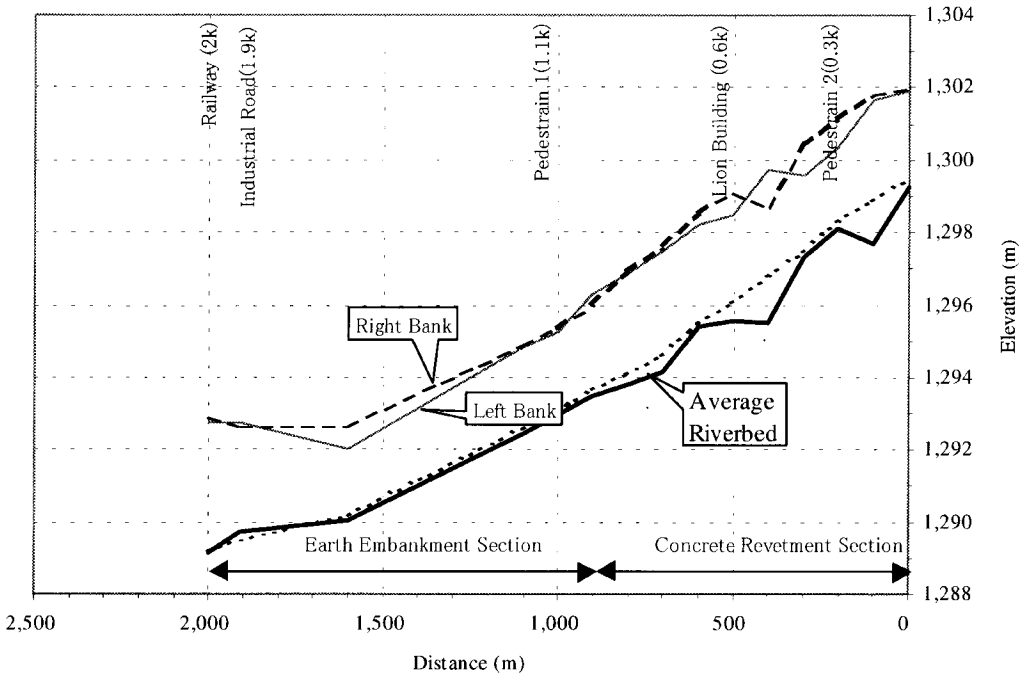
2) Floods of Selbe River and Rainfall

In 1923, historical floods hit Ullanbatar, the Capital of Mongolia, from the Tuul River. The flood water level even reached the Gundange Temple, located at the center of the city and caused serious damage to the public facilities. In 1966, the biggest flood ever recorded in the Selbe River occurred. This flood damaged many houses along the river and inundated many places of the city. The daily rainfall amount recorded at the time was 74 mm. After the 1966 floods, bigger floods with bank-full flow occurred in 1982,1986 and 1992. The daily rainfall amounts of these floods were rather small, about 40 mm, however in most cases considerable pre-precipitation, about 20 % of the daily rainfall have been observed. From this fact, it is considered that the most important elements for flooding are existence of pre-precipitation and condition of land saturation.

3) Present River Flow Capacity

The data on existing river facilities and sections are limited. Hence, a site survey was conducted in the reach from downstream of railway to 2 km upstream. The site survey results, reveal that about 3.5-km reaches in the city section is composed of both an earrthen embankment and concrete revetment with 35 to 40 m-river width. The riverbed slope within the city

section ranges from 1/150 to 1/260 and categorized as considerably steep slope. The river flow capacity at the proposed bridge site with freeboard of 80 cm is estimated at about 300 cm^3/s, while the capacity of upper reaches at about 1 km is about 200 m^3/s (see Fig. 2-3-14 and Table 2-3-12). The present embankment and revetment, for which construction documents were not available, were constructed after 1996 floods by volunteer activities of the citizens. During the field investigations, it was observed that the crown elevation is not linear and quality of the concrete for revetment seems to be not good.



River Flow Capacity

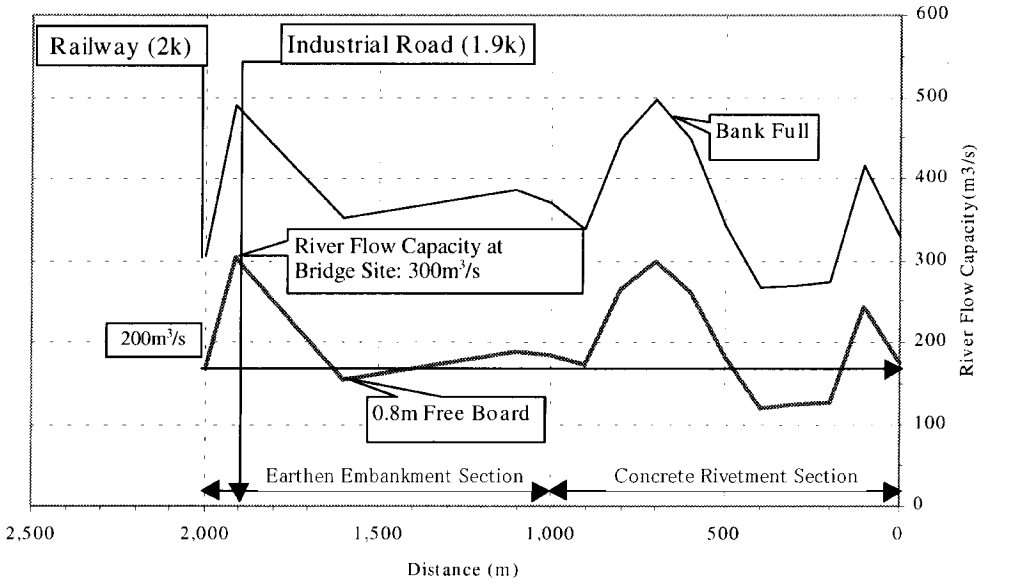


Fig. 2-3-14 River Capacity of Present River Condition

Table 2-3-12 River Capacity of Flow at Teebverchid Road and Upper Stream Reach

Bridge Locations		Distance(m)	Distance(m)	Minimum Bed Elevation (m)	Left Bank(m)	Right Bank(m)	Bed slope	Average Width (m)	Depth-0.0m (Bankfull Section)					Depth-0.8m (with freeboard)				
									Minimum Depth(m)	A(m^2)	R(m)	V(m/s)	Q (m^3/s)	Average Depth	A(m^2)	R(m)	V(m/s)	Q (m^3/s)
Railway	C	2,000	546.85	1289.17	1292.74	1292.88	260	37	2.5	92.5	2.0	3.3	305	1.7	62.9	1.5	2.7	167
17. Dood Selbe (Industrial Road)	B	1,911	458.07	1289.73	1292.76	1292.64	260	44	3.0	132.0	2.4	3.7	490	2.2	96.8	1.9	3.1	303
	1600	1,601	148.11	1290.04	1292.15	1292.63	260	58	2.0	113.1	1.7	3.0	338	1.2	66.7	1.1	2.2	145
Pedestrian1 (Name: Unknown)	1100	1,103	350.31	1292.42	1294.82	1294.86	210	49	2.2	108.8	1.9	3.5	385	1.4	69.6	1.3	2.7	189
	1000	1,003	249.74	1292.94	1295.26	1295.37	210	46	2.3	104.0	1.9	3.6	370	1.5	67.2	1.3	2.8	185
	900	903	149.89	1293.48	1296.29	1295.98	210	42	2.3	95.8	1.9	3.5	339	1.5	62.2	1.3	2.8	171
	800	803	50.14	1293.76	1296.88	1296.93	210	41	2.8	114.0	2.2	3.9	448	2.0	81.2	1.7	3.3	265
	700	703	702.85	1294.14	1297.47	1297.58	150	37	2.9	106.2	2.2	4.7	495	2.1	76.6	1.7	3.9	300
4. Arslant Bridge (so called Lion Bridge)	600	601	601.22	1295.38	1298.24	1298.55	150	36	2.7	98.6	2.2	4.5	447	1.9	69.8	1.6	3.8	263
	500	501	501.29	1295.58	1298.50	1299.08	150	34	2.4	81.6	1.9	4.2	342	1.6	54.4	1.4	3.4	182
	400	401	401.16	1295.50	1299.74	1298.70	150	35	2.0	70.0	1.7	3.8	267	1.2	42.0	1.1	2.8	119
Pedestrian 2 (Name: Unknown) (Flood check section in 1982)	300	301	300.90	1297.35	1299.55	1300.40	150	34	2.0	69.7	1.7	3.9	269	1.2	42.5	1.1	2.9	124
Pedestrian 2 (*) Estimate discharge in 1982	300	301	300.90	1297.35	1299.55	1300.40	150	34	1.9	64.6	1.6	3.7	239					
	200	201	201.14	1298.11	1300.37	1301.12	150	34	2.1	70.4	1.7	3.9	273	1.3	43.2	1.1	2.9	127
	100	101	101.12	1297.70	1301.63	1301.80	150	34	2.7	92.8	2.1	4.5	417	1.9	65.6	1.6	3.7	245
37. Selbe(Dund) Bridge	0	0	0.00	1299.25	1301.89	1301.95	150	33	2.4	78.9	1.9	4.2	329	1.6	52.5	1.4	3.3	175

Note:

1. Bridge location: See location map of bridge.
2. Calculation conditions: n =0.03; For river depths and cross sectional data, see survey results.
3. Minimum depth of railway point: The height between riverbed and underneath of the bridge deck.
4. Pedestrian 2 (*): Flood mark was observed 5 to 10 cm below from top of revetment

(7) Equipment

1) Major Road Construction and Maintenance Company in Ulaanbaatar

Construction and maintenance companies are either under the direct control of the Government (including City Government) or private company. After the implementation of economic reforms, most of the companies are privatized. Road equipment in Mongolia belongs to construction companies. Department of Roads under the umbrella of Ministry of infrastructure or Ulaanbaatar City Government does not directly own any equipment.

Major Road Construction and Maintenance Companies in Ulaanbaatar are shown in Table 2-3-13.

Table 2-3-13 Major Road Construction and Maintenance Company in Ulaanbaatar

Company	G/P	Characteristics
Ulaanbaatar Zam Zasvar	P	Under the direct control of the Ulaanbaatar City Government. The procured equipment in the Project will be transferred to this company after the completion of construction works.
Erdene Zam	G	Under the direct control of the Ministry of Infrastructure. The procured equipment in The Project for Road Construction Utilizing Rock Asphalt in Mongolia was transferred to this company.
Azzan	G	Under the direct control of the Ministry of Infrastructure. A leasing company is affiliated to this company.
Bat Zam	P	Privatized division of the former Road Construction Trust
ASBI	P	Privatized division of the former Road Construction Trust
Huchit Zam	P	Privatized division of the former Road Construction Trust
Gan Guur	P	Privatized division of the former Bridge Construction Trust, Specialty of bridge
Techno Arch	P	Mainly bridge construction and maintenance

Note: G(Government-managed Company Under National Property Control Committee)
P (Private Company Under City Property Control Committee)

2) The Project for Road Construction Utilizing Rock Asphalt in Mongolia

List of procured equipment in "The Project for Road Construction Utilizing Rock Asphalt in Mongolia" and their conditions are shown in "Appendix 6-6, Table-1".

i) Operation

Procured equipment operates at four locations satisfactorily with excellent rate of operation being 70%.

The equipment was checked for the mileage and the number of hours worked during the study. Average mileage of transport vehicle, for example dump truck is about 95,000 km. Average number of hours worked for equipment for road construction, for example bulldozer, excavator and motor-grader is about 3,950 hours. Average number of hours worked for equipment for pavement work, for example asphalt-finisher and macadam roller is about 3,950 hours.

The equipment had been operated for three years, the annual operation period are limited to only six month summer season because of severe winter.

The number of hours worked was proved the equipment operates satisfactorily in consideration of annual operation period.

ii) Organization of Maintenance and Repair

a) Periodical maintenance and easy repairing works are conducted by each operator or driver. On the other hand, general repairing works are conducted by the repairing work team. The repairing work team includes fifteen professionals, consists of two engineers, two chief mechanics, eight mechanics, two welders and one electrician.

b) The maintenance and repairing workshop are not provided sufficiently. But, a mobile workshop facilitates upkeeping of the rate of operation, which was procured on "The Project for Road Construction Utilizing Rock Asphalt in Mongolia". This workshop unit consists of a fixed generator, welding set, crane and other maintenance tools.

c) Through "The Project for Road Construction Utilizing Rock Asphalt in Mongolia", operators, drivers and mechanics were given training in Mongolia, and engineers were trained in Japan. Thus they are competent and experienced in the management of equipment.

3) Ulaanbaatar Zam Zasvar Company

Ulaanbaatar Zam Zasvar Company (hereinafter UBZZ) is under the umbrella of Ulaanbaatar City Government, and will receive the procured equipment after the completion of the project. List of equipment hold by UBZZ is shown in "Appendix 6-6, Table-2".

The holding equipment mainly composed of Russian made dump truck and roller, has become too old for work. There are other three excavators and one dump truck, which were made in South Korea.

UBZZ is under City Property Control Committee, and is given priority of contract for city road maintenance and repairing work by Ulaanbaatar City Government. But, capability of work is insufficient mainly because of lack of equipment for road maintenance and repairing and trained personnel.

The number of staff is one hundred twenty, including fifteen heavy equipment operators, twenty-five drivers and nine repairing mechanics.

UBZZ does not have an appropriate maintenance and repairing workshop as a result, daily check, periodical maintenance and repairing work are conducted either in the storage room or the open.

4) Other Major Road Construction and Maintenance Companies

Lists of holding equipment of other major construction and maintenance companies are shown in "Appendix 6-6, Tables-3 to 9". Their equipment, which are mainly Russian make have become too old for work.

5) Equipment Agency in Mongolia

Major road construction equipment manufacturers in Japan and U.S. have established their agents in Mongolia. These agents conduct sales and repair of equipment and spare parts. Each agency has mechanics, workshop and repairing facilities. Especially, Japanese agencies are in stock of spare parts of 3,000 - 5,000 items, worth 2.5 - 3.0 million U.S. Dollar. If spare parts are not in stock, Japanese agencies are able to supply requested spare parts within 1 - 2 weeks by air in a hurry or 1.0 - 1.5 months by ship facilitating the service system.

2-3-2 Design Concept

(1) Natural Conditions

1) Hydrological Conditions

In order to prepare appropriate design for road, bridge and drainage facilities, it is necessary to consider the specific characteristics of meteoro-hydrological conditions of the basin. In particular, referring to temperature, the average maximum difference between summer and winter even reaches up to 39 °C. The annual rainfall and daily maximum rainfall are rather low at 270 mm and 52 mm respectively. However since 1966, severe flooding occurred four times in 1966, 1982, 1986 and 1992. During these floods, water level raised up to the crown level of existing bridge. This suggests that the river capacity of flow at bridge section should be made larger than that of upper reaches as the minimum requirement. In other words, river section and the elevation of bridge beam should be bigger than that of existing bridge. The design of drainage facility of road also should consider the fact that annual inundation have been occurred due to local heavy rainfall.

2) Geotechniccal Conditions

The sandy gravel layer with N = 23 to 50 exist at the proposed bridge site and the stratum has sufficient bearing capacity. The spread foundation is deemed applicable and practical.

The ground water level was found at GL-2.8 m under riverbed. Since the ground water level fluctuates considerably by rainfall situation and season, it is necessary to examine carefully the seasonal change in the detailed design as it affect excavation planning.

The earthquake lateral seismic factor of kh = 0.1 is adopted even though the Project area is located in Class 8 region and no earthquake-resistant design for the structure is to be considered under Class 6 in Mongolia.

No liquefaction of the ground is considered because of dense Sandy Gravel layer underneath the bridge site.

(2) Social Conditions

The Project will be implemented in the capital city of Mongolia. Following the transition of the country to the market-oriented economy, the number of vehicles is increasing at a rate of 7 % in a year. The number of accidents is also increasing especially at intersections. Therefore, the improvement of Teeverchid Road and three intersections are required to be rehabilitated to function effectively.

(3) Construction Conditions

In recent years, construction works of roads are being implemented with the assistance from the Government of Japan, World Bank, Asian Development Bank and Kuwait Fund. Although the technical transfer is carried out under the foreign assistance, the number of highly qualified staff is still small.

Therefore, the technical transfer for civil works and operation of equipment is required to be carried out by the Japanese supervisors under this Project.

(4) Employment of Local Contractors and Utilization of Local Materials and Equipment

The local construction companies were united under the state-owned construction trust. However, they were restructured into several private and state-owned companies since 1990.

The private and state-owned companies differ from each other by the ownership of their property, but there is no discrimination during tender. During the recent years, they carry out their activities as main contractors or sub-contractors to road construction projects financed by foreign assistance.

Under this Project, local companies will be employed as sub-contractors or as companies leasing equipment or supplying manpower.

Locally produced aggregate, cement and reinforcing bars as well as imported bitumen (straight asphalt) will be supplied from the local market.

Although the local construction equipment are old, heavy equipment such as bulldozers, back hoes and macadam rollers are widely used.

(5) Maintenance Capabilities of the Executing Agency

The most of the city roads are paved by asphalt concrete. However, they are deteriorated gradually since their construction in 1960s. With increase of number of vehicles in recent years, the roads suffer great damages. The Government of Mongolia, recognizing the necessity of their maintenance, has allocated 962 million togrogs from the Road Fund in 1999 and used them for repair of existing roads and bridges.

Since the maintenance of equipment to be supplied under this Project will be carried out by "UB Zam Zasvar" a company specialized in City Road maintenance under the jurisdiction of Ulaanbaatar City, there will be no problem in maintenance of the city roads.

Since the roads to be covered by the Project are located in urban area, besides the electricity charge for traffic signals and lighting, which will become necessary with their hand-over for public use, it is, also, necessary to consider the cost of bitumen required to fill up cracks, which, certainly, occur during winter time. Besides the electricity charge, it is necessary to estimate for this purpose a sum equal to 2 % of the construction cost for a period of three years after the completion of works.

(6) Scope and Grade of Road Facilities and Procurement of Equipment

1) Road Facilities

The industrial road (Teeverchid Road) is defined as the principal trunk road in Ullanbaatar City which is passing between East and South urban area, and this road will be connected to Asian Highway No. 3 in future. The traffic volume of existing 2 lanes road is increasing and already had exceeded its capacity.

From the above conditions, the Japanese Specification shall be applied to the Project facilities. The lane numbers of 2 and 4 on the Project road shall be classified according to the results of traffic survey and after discussion with Mongolian Government.

The scope of the study for bridges shall be determined based on the topographical, geological and hydrological characteristics, traffic survey, location of existing bridge and giving due consideration of experience gained from similar projects in Mongolia.

The Japanese B-Live loading system (TL-25) of design standard shall be applied for bridge design.

The improvement for 3 intersections shall be designed based on Japanese Specification. For the purpose of prevention of many accidents, the intersection shall be designed for the channelization according to traffic volume.

2) Procurement of Equipment

i) Natural conditions

In Mongolia the temperature reaches minus 40°C in the winter. If the equipment is made with "the specification for extreme cold" many of the parts will have to be of high quality material using many intricate structures; and not only will the equipment price increase considerably but also the price of spare parts will also increase considerably.

In consideration for the project, the equipment will be utilized in the summer. Therefore, "the specification for cold ", which is similar to the equipment utilized in Hokkaido, the coldest region in Japan will be applied to the equipment procured. "The Project for Road Construction Utilizing Rock Asphalt in Mongolia" under the Japanese general grant also applied equipment similar in specifications to those used in Hokkaido and they are working satisfactorily following suitable operation, selection of lubrication oil and routine maintenance.

ii) Executing Agency's Technical Level and the Quality of the Equipment.

Through the basic design study, it has been confirmed that the technical level of the operator is normal and the daily maintenance ability is standard.

At present the equipment belonging to the city are predominantly former USSR or East European products and are of very simple structure. Because of this, the equipment to be procured will be a standard type and of simple structure.

iii) Procurement Concept

The equipment to be procured under the project is not manufactured in Mongolia.

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

- 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

However, 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.

(7) Construction Schedule

The main cause, which may effect the time schedule, is cold period. The schedule for earth works, pavement works and concrete may be greatly affected by the natural conditions.

While taking into consideration the limits to be put by the cold season on construction works, it will be necessary to consider the implementation of works possible during the winter time and to draft out an appropriate execution plan.

2-3-3 Basic Design for Improvement of Teeverchid Road

(1) Basic Design

1) Standards and Guidelines

The following standards and guidelines were adapted for basic design.

- Japanese Highway Standard
- Asphalt Pavement Standard : Japan Road Association
- Drainage Guideline : Japan Road Association
- Guideline for At-grade Intersection

2) Geometric Standard

Geometric Standard was established in consideration for roles and functions of Teeverchid Road as shown in Table 2-3-14.

Table 2-3-14 Geometric Standard

Item	Unit	Figure
Terrain	-	Flat
Design Speed	Km/h	60
Stopping Distance	m	75
Crossfall	%	2.0
Minimum Curve Radius	m	150
Minimum Curve Radius without Transit Curve	m	500
Maximum Gradient	%	5.0
Minimum Vertical Curve Length	m	50
Maximum Superelevation	%	6.0
Vertical Clearence	m	5.0

3) Typical Cross Sections and Sections of Improvement

Six typical cross sections are set in consideration with roadside situations and required lanes by the relationship between traffic volume and traffic capacity. Six typical cross sections are shown in Fig. 2-3-15.

Fig. 2-3-16 shows section of improvement that is determined based on the results of road surface condition survey, and shows the relationship between typical cross sections and sections of improvement.

4) Alignment

Alignment is set with the following considerations, as detailed in Appendix 6-7.

i) Horizontal Alignment

- Horizontal alignment will be planed to use existing road
- Horizontal alignment will be set to avoid site of railway, if possible
- Existing Selbe Bridge will be used as detour road under construction
- East section from Peace Bridge will be widened to south to spread open space.

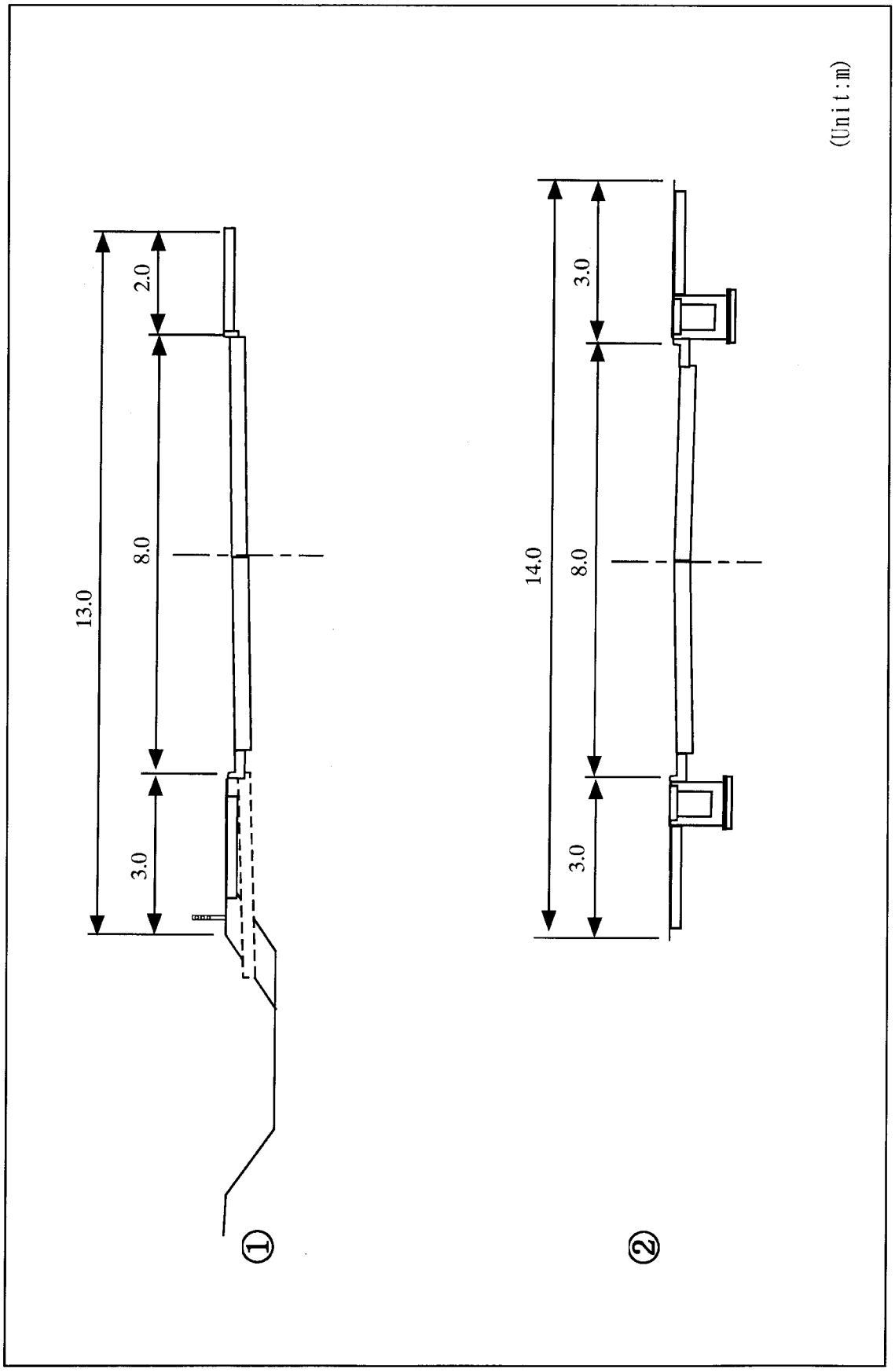


Fig. 2-3-15 Typical Cross Section (1/3)

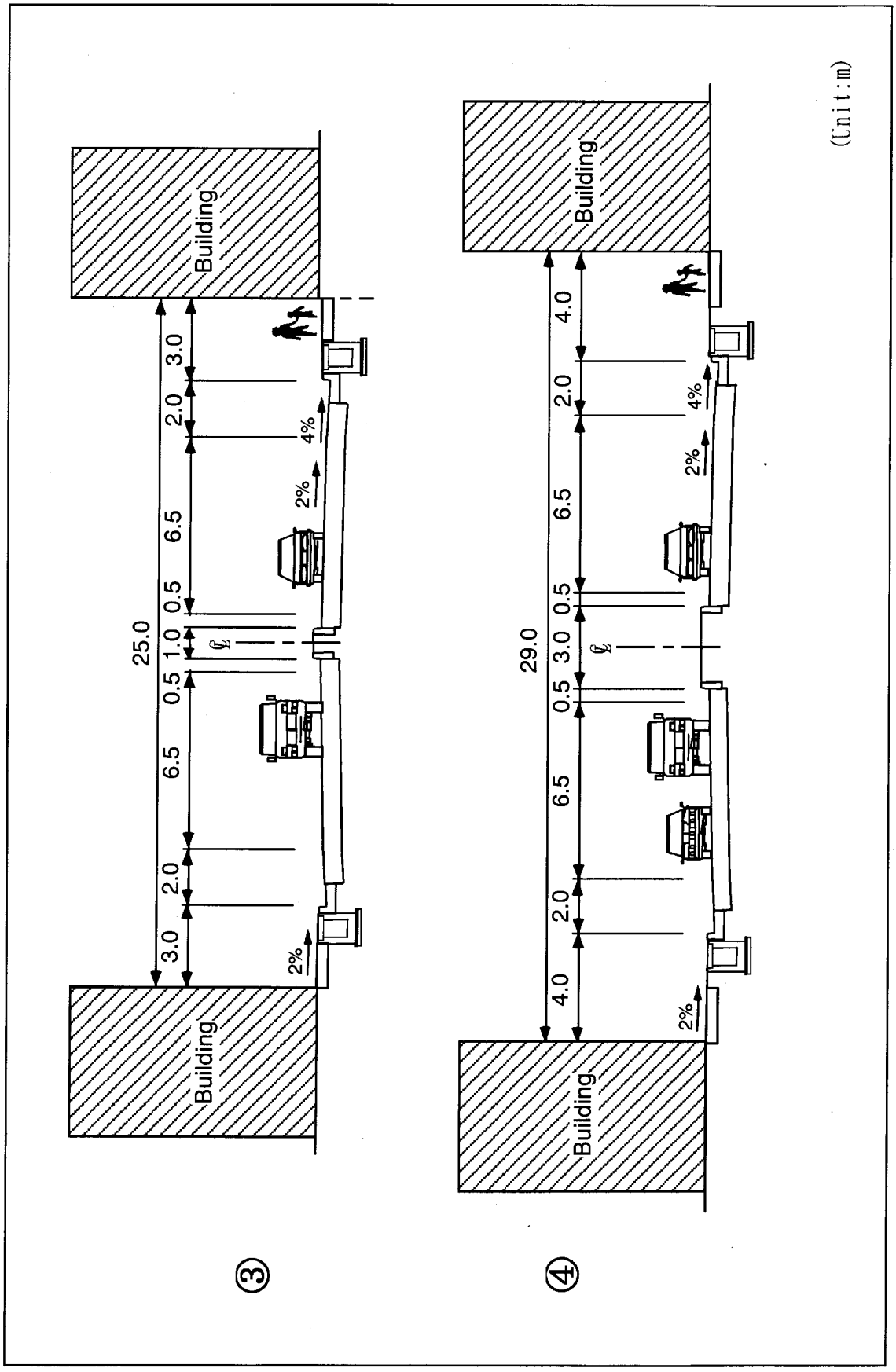


Fig. 2-3-15 Typical Cross Section (2/3)

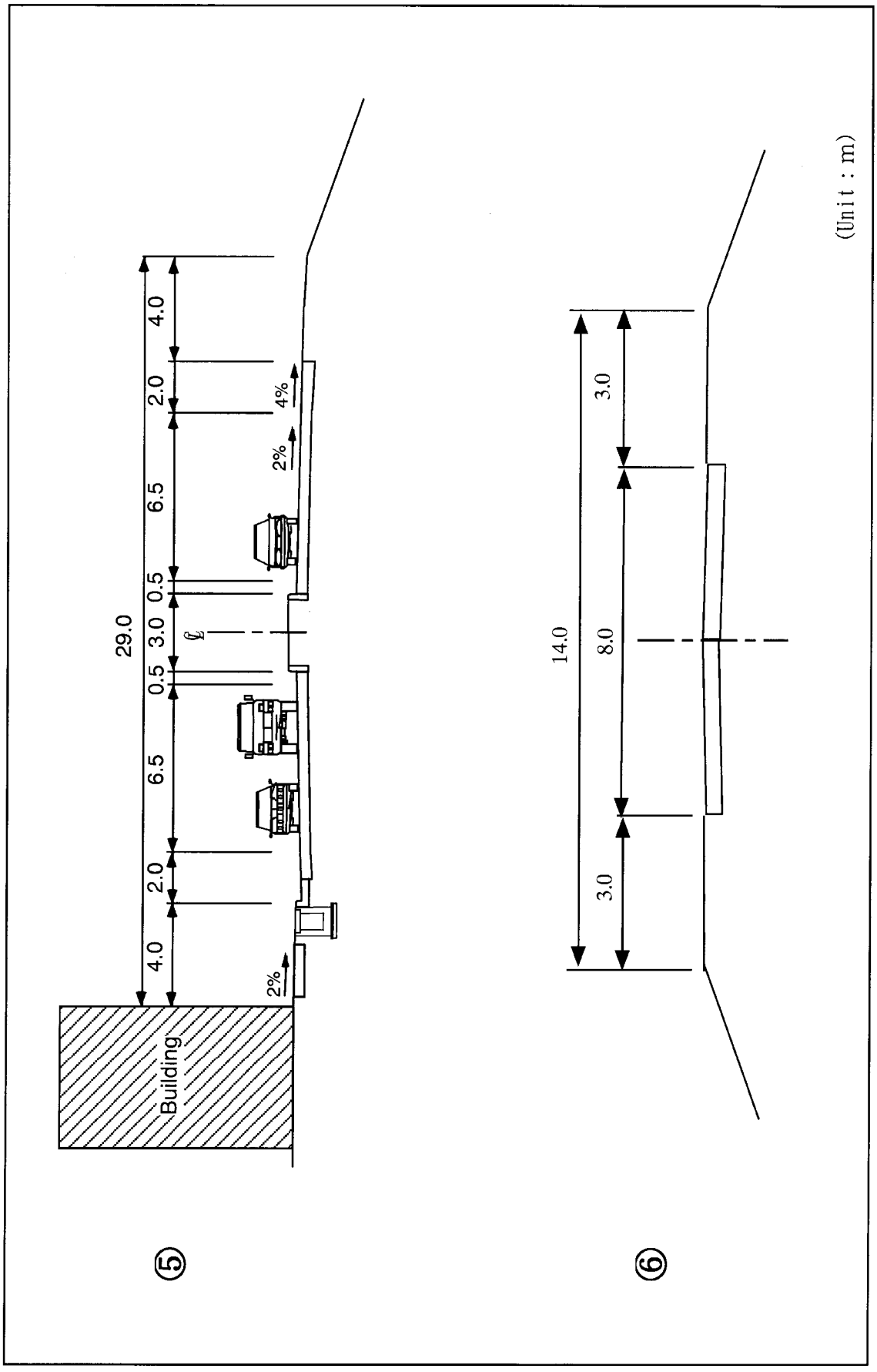


Fig. 2-3-15 Typical Cross Section (3/3)