14) Planting Trees and Monuments

a) Planting trees

Planting trees shall be provided at 4 intersections and Road-side Station from the following viewpoint.

- Planting trees shall alleviate wind and snowfall at intersection.
- Planting trees shall mitigate noise and air pollution at Road-side Station and provide beautification as well.

b) Monuments

The monuments shall be set up at the following locations.

- Section II : Near Kherlen Bridge
- Section VI : West Undurkhaan Intersection

(2) Bridge Design

1) Outline

The results of site investigation and further study concluded that the four bridges in the study area, Khujirt, Khutsaa Nariin, Kherlen and Murun, are not feasible to be rehabilitated from economical viewpoints. Three bridges which are located on the new construction section, Khutsaa Nariin, Kherlen and Murun, are planned to be constructed newly, and the other which is located on the rehabilitation section, Khjirt, is to be reconstructed. The following table shows the outline of the existing bridges.

Table 2-2-2-14 Outline of the Existing Bridges

Name	Contents	The Existing Condition	Reasons for New Bridge Construction
Khujirt No.1+717 （Section II）	• Type: RC Slab • Length: 9.0m (2@4.5) • Constructed: 1970's	• Cracks and gaps on the pavement • Backfill and base course material washed away between slab and abutment members • Displacement of abutment and retaining wall by earth pressure of backfill material. • Lime water leaking and neutralization on going on slab • Lack of river flow section	The existing bridges • is incapable of loading required AASHTO live load • need river width of 15m • has collapsed retaining wall • is difficult to maintain the smoothness of pavement due to backfill and base course material washed away
Khutsaa Nariin No.21+889 （Section II）	• Type: Timber • Length:14.7m (9.2+4.5) • Constructed: 1995	• Severe damage by heavy vehicles • Some maintenance work (replacement of slab deck) done after F/S. • Lack of river flow section	The existing bridges • is incapable of loading required AASHTO live load • need river width of 17.5m
Kherlen No.29+968 （Section II）	• Type: RC-T Girder (Caissons Foundation) • Length268.8m (16@16.6m) • Constructed: 1974	• No cross girders • Cracks caused cy searing force and bending moment on main girders • Covering concrete stripped and re-bar exposed on the bottom and end (around bearing shoes) of main girders • Severe damages on bearing shoes, expansion joints and handrails • Gap between main girders above adjoining piers is extended, possibilities of displacement of piers caused by scouring	The existing bridges • is incapable of loading required AASHTO live load • can only bear 14t vehicles by rehabilitation • has very few feasibility for reinforcement technically (quality) and economically
Murun No.303+430 （Section VI）	• Type: Timber • Length: 19.6m (5@3.9) • Constructed: 1962	• Severe damage by heavy vehicles, especially on the slab deck • Hardly any maintenance work done • Lack of river flow section	The existing bridges • is incapable of loading required AASHTO live load • need river width of 52.5m

The basic design is prepared for each bridge from the study results of the existing bridges mentioned above. The outline of basic design is as follows:

a) Khujirt Bridge (17.5m)

The existing Khujirt Bridge lies on the Section II and about 2km from beginning point. It is in the straight alignment around 7km. Embankment is 3m high behind the abutments and backfill materials are washed away by rain.

Since the existing RC-slab bridge has structural defects and insufficient soundness, replacement by new bridge is necessary. The existing bridge will be removed and the new bridge is planned to be constructed at the same location because of no realignment of the road due to the rehabilitation section.

This part of National Highway No. 0501 connects Ulaanbaatar (Capital city of Mongolia) and Baganuur (main coal supply to the capital). A detour road is required to maintain existing traffic and to secure space for the removal work of the existing bridge during the construction. The detour is planned to be placed on the north side of highway. (refer to Figure 2-2-2-17)

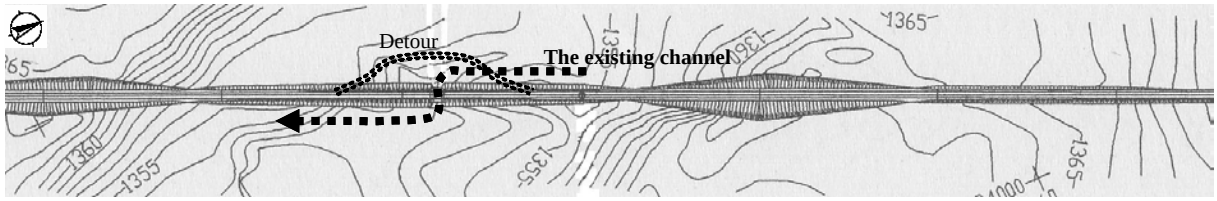


Figure 2-2-2-17 Plan of Khujirt Bridge Site and its Surroundings

The existing channel is natural water flow without any river improvement. Flow runs from north to south along the embankment and passes beneath the road. Since the valley crosses with the road alignment by the angle of 60° approximately, new bridge is planned to have 60° of skew angle.

New bridge is set to be 17.5m in length with one span from the design discharge (50 year return period) and river flow section. Superstructure is RC T-shaped girder and substructure is RC reversed T-shaped with spread foundation.

b) Khutsaa Nariin Bridge (17.5m)

Khutsaa Nariin Bridge lies on the new construction section of Section II. The new road alignment is planned about 90m north parallel to the existing earth road. It is about 5.7km from the Baganuur Mining Intersection.

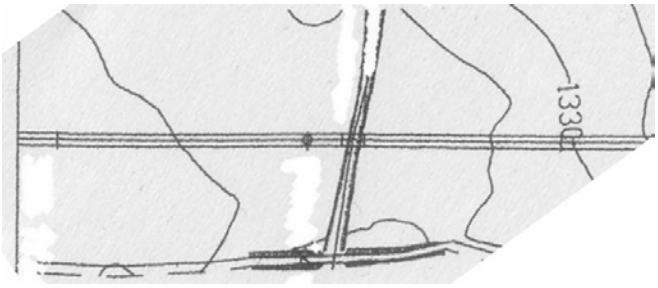


Figure 2-2-2-18
Plan of Khutsaa Nariin Bridge Site and its Surroundings

Site is in the plain field and the Khutsaa Nariin River runs from north-east to south-west with 10m wide and 1 to 2m deep natural channel. The bridge is not very large and the channel does not have any river improvement plan. So the new bridge, the crossing angle of alignment of which with existing channel is 80° , is planned as right-angle bridge, same as those of existing bridge. (refer to Figure 2-2-2-18)

The existing bridge will be used for the traffic during the construction. Since the construction vehicles have the probability to harm the existing bridge by their heavy load

and high frequency of crossing, they will be prohibited to go across the existing bridge. Temporary road with corrugate pipes will be installed for the construction.

New bridge is set to be 17.5m in length with one span from the design discharge (50 year return period) and river flow section. Superstructure is RC T-shaped girder and substructure is RC reversed T-shaped with spread foundation.

c) Kherlen Bridge (16@16.8=268.8m)

Kherlen Bridge lies very near to the end point of Section II and new construction section of Section II. It is about 13.7km from Baganuur Mining Intersection. New bridge is planned 30m downstream to the existing bridge. The existing bridge will be used for pedestrian domestic animals after completion of new bridge.

Existing river crossing point is located at the narrow path of the Kherlen River and hilly terrain exists on the west bank where low land at around the crossing point extends 800m wide. However, the existing bridge is only 268.8m together with approach roads on the embankment that are protected by revetment on the riverbed. New bridge is aligned 30m parallel to the existing bridge with same total and span length. (refer to Figure 2-2-2-19)

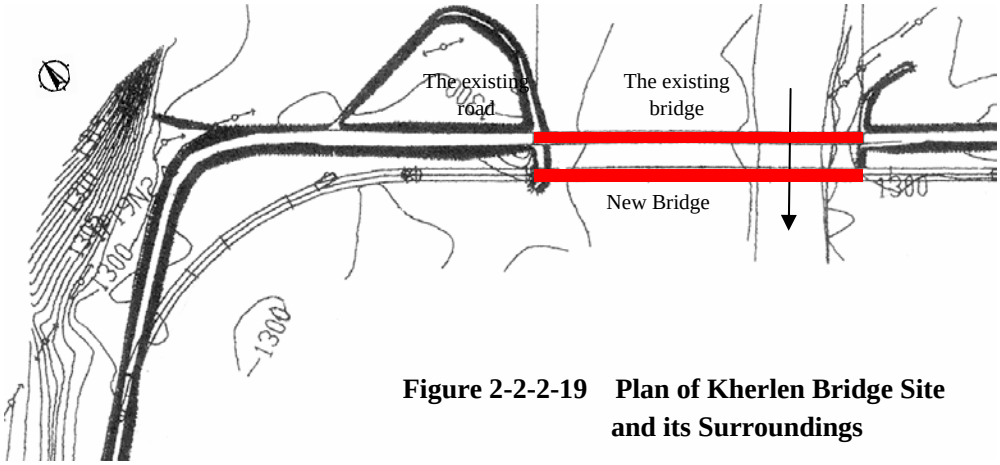


Figure 2-2-2-19 Plan of Kherlen Bridge Site and its Surroundings

The existing bridge will be used for the traffic during the construction. Since the construction vehicles have the probability to harm the existing bridge by their heavy load and high frequency of crossing, they will be prohibited to go across the existing bridge. Temporary road and bridge will be installed for the construction.

Since the construction of substructure will be on the riverbed the main stream will have to be shifted temporarily to make construction work possible to handle on the dry condition. Excavating of six substructures (P6 – P11) will be in practice with cut-off by steel sheet piles. These are selected by calculating output of underground water by well theory.

Although the required bridge length is 350m according to the hydrological study, bridge length of new bridge was fixed to 16@26.8m=268.8m, same as that of existing bridge. This is because the existing bridge will stay and there is no plan of removal of it. It is not reasonable to construct new bridge over 350m on condition that the existing bridge exists as it is. However, the abutment is designed to be able to transform to pier for the future expansion of the bridge to flow the design discharge.

New bridge will have RC T-shaped girder as superstructure and RC reversed T-shaped abutment and T-shaped pier with spread foundation.

d) Murun Bridge (3@17.5=52.5m)

Murun Bridge lies on the Section VI, 2km from the beginning point and 26km from Undurkhaan. Road separates from the exiting earth road about 300m towards the beginning point and crosses the river about 40m upstream to the existing bridge. (refer to Figure 2-2-2-20)

Although the Murun River runs with sharp skew angle near the site, it meanders widely in the surroundings and crosses at the right angle with the road alignment.

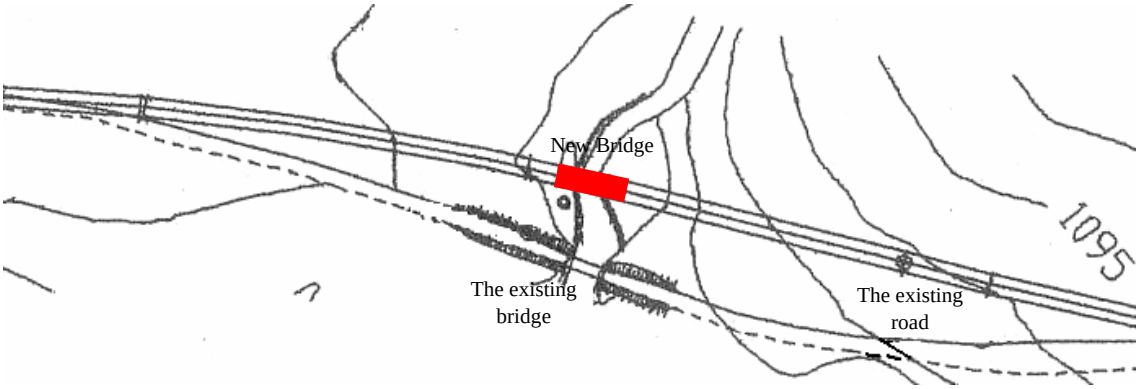


Figure 2-2-2-20 Plan of Murun Bridge Site and its Surroundings

The existing bridge will be used for the traffic during the construction. Since the construction vehicles have the probability to harm the existing bridge by their heavy load and high frequency of crossing, they will be prohibited to go across the existing bridge. Temporary road with corrugate pipes will be installed for the construction.

New bridge is set to be 52.5m in length with three spans from the design discharge (50 year return period) and river flow section. Span length is set to 17.5m considering the efficiency of construction. Superstructure is RC T-shaped girder and substructure is RC reversed T-shaped abutments and T-shaped piers with spread foundation.

2) Design Condition

a) Design Criteria

Mongolian standard for bridges and culverts are applied for the design. On the other hand Japanese Specification for Highway and Bridges satisfies the Mongolian standard mostly; it can be utilized for designing.

- Designing of Road Bridges and Culverts (BNbD 32.02.03), Ministry of Infrastructure, Mongolia, 2004
- Specification for Highway Bridges, Japan Road Association, 2002

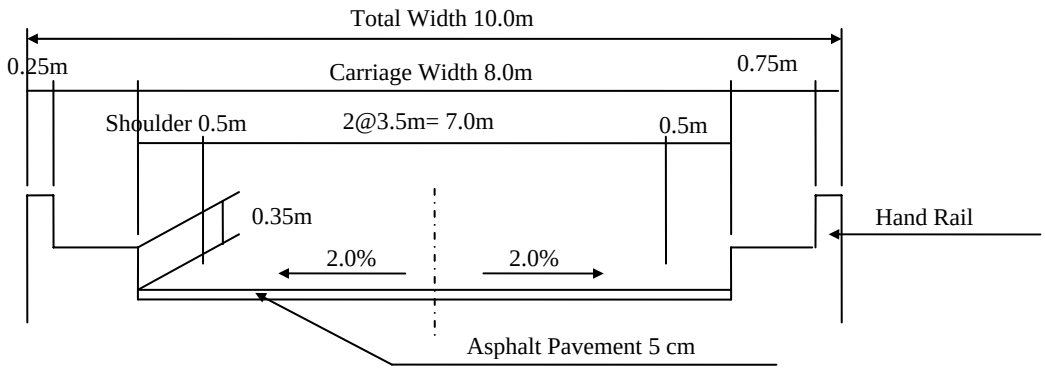
b) Location

The following table indicates the location of new bridges as station number. It is basically same with F/S.

Bridge	Station No. (A1)	Location
Khujirt	No.1+716.5	Replacement of the existing bridge
Khutsaa Nariin	No.21+889.1	About 90m upstream to the existing bridge
Kherlen	No.29+967.5	30m downstream to the existing bridge
Murun	No.303+430	About 40m downstream to the existing bridge

c) Cross Section

F/S proposed total width 9.0m without sidewalk, which have changed to 10.0m with 0.75 sidewalk on both side. It will be used for maintenance and inspection as well. It was agreed between Mongolian side and the study team. Cross section is one of the standard cross section of Mongolian standard.



d) Strength of Concrete

Strength of Concrete is determined in accordance with those of existing structures in Japan. Rich cement concrete is preferable to avoid cracks on the superstructure caused by water permission and deterioration. σck = 24 N/mm^2 is applied for concrete of superstructure. This will improve both ease and cost of maintenance.

RC girder, RC Slab, Cross Beam	σck = 24 N/mm^2	Approach Wall	σck = 21 N/mm^2
RC Hand Rail	σck = 21 N/mm^2	RC Box Culvert	σck = 21 N/mm^2
Abutment, Pier	σck = 21 N/mm^2	RC Pipe Culvert (Precast)	σck = 21 N/mm^2

d) Reinforcing Bar

Deformed bar with equivalent strength of SD295 will be the reinforcement bar for RC structure. This re-bar is refined in Darkhan iron foudry.

f) Load Condition

- Dead Load

The following table shows the agreed dead load between the Mongolian side and the study team.

Type	Unit Weight (kN/m^3)	Type	Unit Weight (kN/m^3)
Steel or cast steel	77	Compacted sand, earth/gravel	19
Concrete(plain)	23	Loose sand, earth, and gravel	18
Concrete(reinforced/prestressed)	24.5	Under ground water	10
Asphalt pavement	22.5		

- Live load

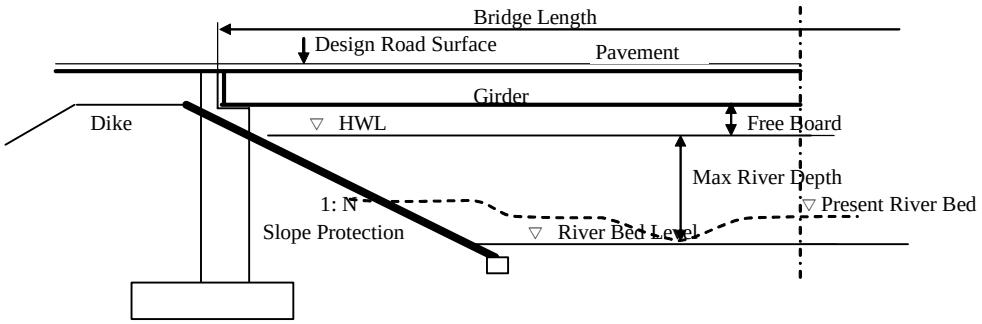
Four bridges in this project forms Asian Highway and required to bear AASHTO HS20-44.

- Other Loads

The following table shows the agreed dead load between the Mongolian side and the study team.

Type	Specification	Remarks
Earthquake	Design coefficient Kh = 0.10	Mongolian Standard (BNbD 22-01-01),
Earth pressure	Coulomb theory	Japanese Specification
Impact of Ice Floe	430kN (Kherlen) 420kN (Murun)	AASHTO
Temperature	-40°C～+40°C	Mongolian Standard of Meteorology
Snow	Not needed	Mongolian Standard

g) River



Name of Bridge	Khujirt	Khutsaa Nariin	Kherlen	Murun
Discharge (Q m^3/s)	143	165	1,100	350
Bridge Length	17.5m	17.5m	268.8m	52.5m
Skew Angle (Degrees)	60	90	90	90
Riverbed Level (Min.)	1,351.5m	1,327.38m	(1,296.47m)	(1,090.17m)
Max. River Depth	1.3m	1.62m	3.98m	1.98m
High Water level (GL)	1,352.9m	1,328.8m	1,300.45m	1,092.15m
Minimum Free Board	0.6m	1.0m	1.0m	1.0m
Minimum Elevation of bottom surface of girder	1,353.5m	1,329.8m	1,301.45m	1,093.15m
Elevation of bottom surface of girder of the existing bridge	-	-	1,301.8m	-
Height of Girder + Pavement	1.48m	1.48m	1.48m	1.48m
Minimum Road Surface Level	1354.98m	1331.28m	1303.28m	1094.63m
Return Period (years)	50 years and more	50 years and more	50 years and more	50 years and more
Location of Revetment (Dike)	Upstream and downstream	-	Downstream	-
Elevation of Top surface of Revetment	1353.50m	1329.80m	1301.45m	1093.15m
Slope of Protection (1:N)	1:1.5	1:1.5	1:2.0	1:1.5
Scouring Depth	-	-	2.99m	1.49m
Margin Depth	-	-	2.50m	2.50m
Maximum Elevation of the bottom surface of footing	-	-	1,290.98m	1,086.18m

h) Bearing Layer

Borehole logging revealed the soil consists of mainly gravel. It also includes sand and silt but bearing layers with high N-value (results of standard penetration test) are all gravel

layers. Since gravel layers tend to have higher N-value than reality, Minimum N-value of bearing layer is set to 50. Spread layer must be penetrated into bearing layer for more than 50cm. The following table indicates the bearing layer and applied boreholes for each substructure.

Name	A1	A2	P1	P2	Piers
Khujirt	1347.60m SEBH-1	1347.19m SEBH-2	-	-	-
Khutsaa Nariin	1324.40m SEBH-3	1324.08m SEBH-4	-	-	-
Kherlen	1297.55m SEBH-8	1298.36m SEBH-11	-	-	1297.55m (SEBH-8: P1-2) 1298.77m (SEBH-9: P4-7) 1298.11m (SEBH-10: P8-12) 1298.36m (SEBH-11: P13-15)
Murun	1088.60m SEBH-12	1090.33m SEBH-14	1088.60m SEBH-12	1090.16m SEBH-13	-

i) Miscelenious

Item	Specification	Remarks
Bearing Shoe	Rubber	-
Expansion Joint	Steel or Rubber	-
Expansion Gap	Minimum width 50mm	In case Effect of Temperature is over 50 mm, it will be considered

j) Scouring

Although annual precipitation is very scarce, rainfall concentrates in short term. The countermeasure against scouring is planned considering the infiltration and evaporation capacity of the site (mainly grassland). Khujirt and Khutsaa Nariin will have leveling concrete below the girders and stone masonry on the up and downstream of it. Riprap is not selected to secure a path for domestic animals under the girder in dry season and winter.

Scouring depth is calculated for the piers of Kherlen and Murun Bridge. The depth was calculated using Mongolian standard, JR's (Japan Railway) Standard and Proposal of Public Works Research Institute of Japan. Mongolian standard is superior for calculating and modeling these two bridges. The following figure shows the outline of Mongolian standard for calculating of scouring. (refer to Figure 2-2-2-21)

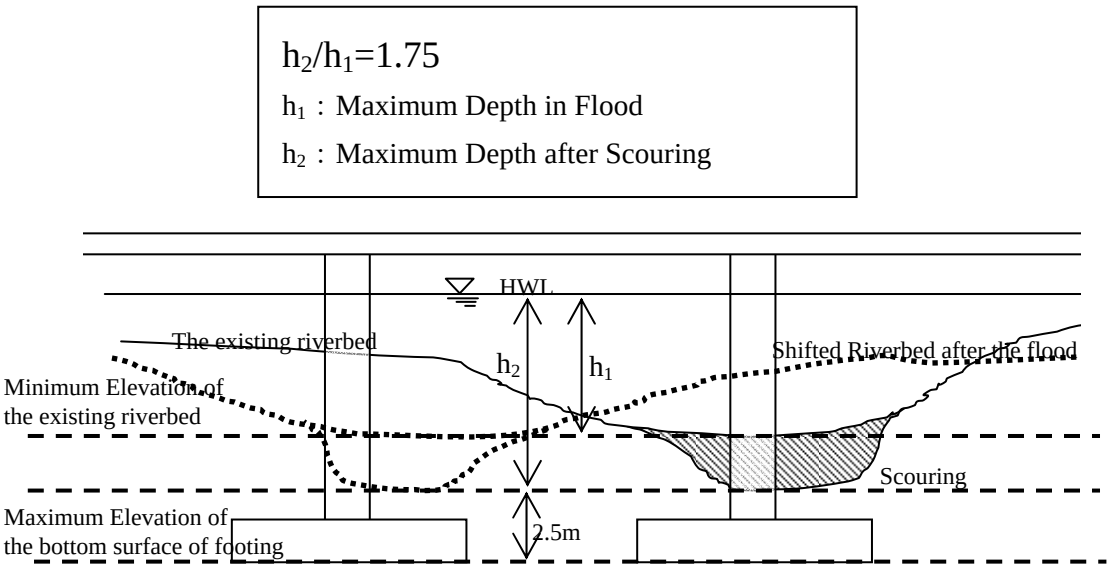


Figure 2-2-2-21 Outline of Mongolian Standard for Calculating of Scouring

Footing Elevation of all substructures will be same considering the site geography and Concept of "Government Ordinance for Structural Standard for River Administration Facilities, Japan River Association 1998". Abutments of Murun is excluded due to the revetment in front of them.

	Kherlen	Murun
Scouring Depth ($h_2 - h_1$)	2.99m	1.49m
Margin Depth	2.50m	2.50m
Maximum Elevation of the bottom surface of footing	1,290.98m	1,086.18m

k) Revetment and Riverbed Protection

Dike is planned for Kherlen and Khujirt Bridge. Khujirt Bridge will have guide bank on the upstream south bank because it has skew angle and the guide bank will bend the flow. Kherlen Bridge is planned to have dike only on the downstream because it has the existing embankment on the upstream. Slope will be protected by stone masonry and Riprap for apron. Khutsaa Nariin and Murun Bridge will have stone masonry on the slope and Riprap for apron.

Riverbed protection will be leveling concrete, stone masonry and riprap. Khujirt and Khutsaa Nariin bridge will not be protected by riprap to secure a path for domestic animals.

Name	In front of Abutment	Around Piers	Riverbed under the girders	Remarks
Khujirt	Leveling Concrete	-	Leveling Concrete	Stone Masonry on the up and downstream of Leveling Concrete
Khutsaa Nariin	Leveling Concrete	-	Leveling Concrete	
Kherlen	Riprap	Riprap	-	
Murun	Riprap	Riprap	-	

l) Future Plan for Kherlen Bridge

New Kherlen Bridge does not have enough river flow section for design discharge (1,100 m^3/s). Although adequate bridge length to cope with design discharge is 350m according to the hydrological study, bridge length of new bridge was decided same as that of existing bridge. This is because the existing bridge will stay and there is no plan of removal of it. It however will be designed to extend to satisfy sufficient river flow section after removal of the existing bridge. Two abutments will be designed as both abutment and pier. The bridges will be extended two spans to east and three spans to west (RC-T girder bridge). Total length is planned to be 352.8m.

m) Construction Period

Mongolia has hard winter with several months that have maximum temperature below 0°C. The construction period of each work item of bridge construction will be limited as follows:

- Superstructure : 5/11～9/20
- Substructure (Normal Concrete) : 5/11～9/20
- Substructure (Winter Concrete) : 9/21～5/10
- Bridge Surface : 5/11～9/20
- Earth Work : 4/16～10/15
- Pre-cast Concrete (Indoor) : All year round

3) Selection of Bridge Type

Bridge Type is selected to classify into two groups considering bridge length, namely 1) Kherlen Bridge, 2) Khujirt, Khutsaa Nariin and Murun Bridge. Only Kherlen Bridge is large scale over 200m.

a) Kherlen Bridge

The type of Kherlen Bridge is selected to optimize practicability from technical aspects and to secure economic feasibility. According to F/S, concrete bridge was superior to

steel bridge. This result was judged reasonable and accordingly comparison was made among concrete bridges. F/S also proposes that the new bridge should be constructed 30m downstream parallel to the existing bridge that consists of 16 spans of 16.8m/span (16@16.8=268.8m).

i) Span Length

The existing bridge is planned to be utilized together with new bridge, and span length of new bridge is to be the same as that of the existing bridge due to avoiding any stagger of piers and maintaining the river flow. Two alternatives are deliberated, "① 16@16.8m as same as the existing" and "② 8@33.6m as double length as the existing".

The new bridge is designed to select the alternative "① 16@16.8m as same as the existing" by the following reasons.

- Economical due to shallow bearing layers (Spread Foundation is applied)
- Most of the materials can be procured locally
- "② 8@33.6m as double length as the existing" cannot improve impediment ratio of river flow due to the existence of the existing piers.

ii) Erection Method

The following are the conditions of erection method.

- Construction period of each work item is as 2) Design Condition m) Construction Period
- Water level fluctuates from May to September to cause flood sometimes
- Span length will be "① 16@16.8m as same as the existing" as mentioned above.

Three alternatives are examined, "①by Crane", "②by Erection Girder" and "③ Cast-in-situ". "①by Crane" is applied due to the following reasons:

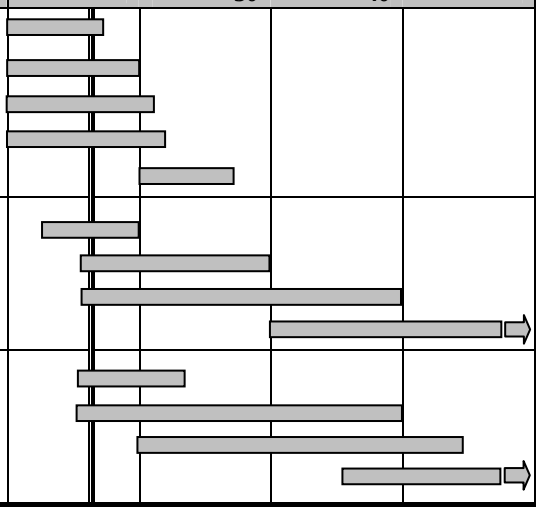
- 40t class crane is available in Ulaanbaatar.
- Erection Girder is not available in Mongolia.
- All-staging method represents the erection method of Cast-in-situ, but construction period falls on flood-prone period. All-staging method will be exposed to the risk of collapse by flood.
- Other support materials such as girder type support are not available in Mongolia.
- Erection by crane allows casting girders and substructure simultaneously to reduce construction period.

iii) Superstructure Type

According to the above mentioned considerations of Span Length and Erection Method, superstructure types are considered. Three alternatives are selected from following table. "①RC Composite Girder", "②RC-T Girder" "③PC Pre-tension Hollow Slab"

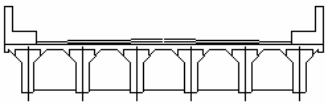
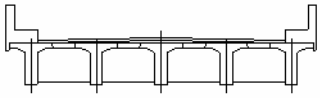
Table 2-2-2-15 Applicable Span Length

Type of Bridge		Span Length (m) 17 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 Composite Girder		1/13-18
	Simple Box Girder		1/18
PC Bridge	Simple Slab		1/18
	Simple/continuous Hollow Slab		1/18-22
	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



"① RC Composite Girder", "② RC-T Girder" are applicable for the Kherlen Bridge. The following table shows the details of consideration.

Table 2-2-2-16 Comparison Table for Superstructure Type

	①RC Composite Girder	②RC-T Girder	③PC Pre-tension Hollow Slab
Outline	①Cast main girders at the construction yard ②Erect main girder by crane ③Cast slab and cross beam in-situ 	①Cast main girders at the construction yard ②Erect main girder by crane Cast slab (between girders) and cross beam in-situ 	①Cast main girders at the construction yard ②Erect main girder by crane ③Cast slab (between girders) in-situ ④Tensioning work for traversal PC strand 
Advantage	・Girder is relatively light ・Erecting main girders are relatively easy ・Casting main girders are easy ・Economical	・Minimum volume for cast-in-situ ・Casting main girders are easy ・Minimum construction period ・Economical	・Main girder is lightest ・Erecting main girders are easy ・Low volume for cast-in-situ ・Short construction period
Disadvantage	・Maximum volume for cast-in-situ ・Maximum construction period	・Main Girder will be heaviest ・Crane scale will be large	・Pre-tension equipments are not available ・Specific technique is required for Pre-stressing ・High Cost
Erection Method	・Two 25t class crane or ・One 40t class crane	・Two 40class crane or ・One 70 class crane	・One 25t class crane
Validity	High validity Most of materials and equipments are procurable domestically and economical	High validity Most of materials and equipments are procurable domestically and economical	Low validity Main materials and equipment are not procurable and difficult to utilize local construction skill Uneconomical
Priority	Prime	Prime	inadequate

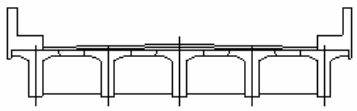
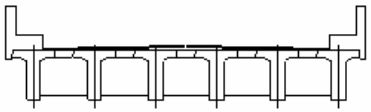
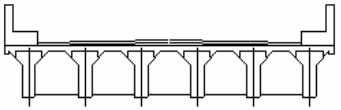
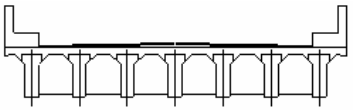
iv) Section of Superstructure

According to the comparison above, RC-T and RC composite by crane will be adopted. Considered number of girders are five and six for RC-T and six and seven for RC Composite girder. The following points are taken into consideration:

- Crane is only up to 40t class which is available in Mongolia.
- Cost proportionate with the concrete volume of the superstructure
- Comparison factors are superstructure weight, construction period and ease of construction
- Work area of crane is 6.0 (boom length=6.0m)

RC-T girder with five main girders is applied for Kherlen Bridge. The following table shows the details of consideration.

Table 2-2-2-17 Comparison of Section

	①RC-T Girder, Five Main Girders	②RC-T Girder, Six Main Girders	③RC Composite Girder, Six Main Girders	④RC Composite Girder, Seven Main Girders
Outline	 Height: 1350mm Weight: 32.2t/girder	 Height: 1300mm Weight: 28.8t/girder	 Height: 1350mm Weight: 27.7t/girder	 Height: 1250mm Weight: 23.1t/girder
Crane	Two 40t Class Crane	Two 25t Class Crane	Two 25t Class Crane	Two 25t Class Crane or One 40t Class Crane
Superstructure weight	217t ［Most Economical］	226t ［Second Economical］	295t ［Highest Cost］	289t ［Second Highest Cost］
Construction Period	Shortest 30 months	Shortest 30 months	2 months longer than RC-T girder 32 months	2 months longer than RC-T girder 32 months
Ease of construction	Less volume for cast-in-situ Easy to control quality	Less volume for cast-in-situ Easy to control quality	More volume for cast-in-situ Volume of quality control increases compare to RC-T Girder	More volume for cast-in-situ Volume of quality control increases compare to RC-T Girder
Validity	High Validity Most of materials and equipments are procurable in Mongolia, short construction period and most economical	High Validity Most of materials and equipments are procurable in Mongolia and short construction period but less economical than ①	Low Validity Most of materials and equipments are procurable in Mongolia Longer construction period and less economical than ①	Low Validity Most of materials and equipments are procurable in Mongolia Longer construction period and less economical than ①
Priority	Prime	Secondary	inadequate	inadequate

b) Khujirt, Khutsaa Nariin and Murun Bridge

No major changes in design condition have occurred since F/S. The basic plan is as same as F/S for these three bridges.

i) Span Length

Same Span length with F/S for Khutsaa Nariin and Murun Bride

- Khutsaa Nariin Bridge : 17.5m (Single Span)
- Murun Bridge : 3@17.5＝52.5m

Extension of Span length was made from 15m to 17.5m due to setting skew angle of 60° to Khujirt Bridge

- Khujirt Bridge : 17.5m (Single Span)

ii) Erection Method

Same erection method with Kherlen Bridge (by Crane) is applied to improve project efficiency.

iii) Superstructure Type

Same RC-T girder is applied to improve project efficiency.

iv) Section

According to Kherlen Bridge, RC-T girder with five main girder is applied. Although girder weight will be increased to 33.5t, it is still capable for two 40t class crane to erect.

c) Structure Type

Substructure and foundation type is as same as F/S due to no major changes in design conditions.

Name	Superstructure	Substructure		
		Abutment	Pier	Foundation
Khujirt	RC-T	Reverse-T	T-shaped	Spread
Khutsaa Narin	RC-T	Reverse-T	T-shaped	Spread
Kherlen	RC-T	Reverse-T	T-shaped	Spread
Murun	RC-T	Reverse-T	T-shaped	Spread

2-2-2-3 Basic Plan for Improvement of Equipment

(1) Procurement Plan of Equipment

The Eastern Arterial Road that is the road section from Erdene to Undurkhaan on National Highway No. 0501 is the eastern part of the Millennium Road, and it comprises 6 sections, total 260km long. After completion of Eastern Arterial Road, National Highway No. 0501 is paved from Ulaanbaatar to Undurkhaan, total 330km in length. The national road maintenance company AZZA Tuv having a branch in Baganuur is responsible for 135km stretch from Ulaanbaatar to Baganuur, while the national road maintenance company HARGUI is responsible for 199km stretch from Baganuur to Undurkhaan. However, road maintenance ability of both maintenance companies decreases year by year because equipment that is available in both maintenance companies are old and obsolete enough to decline operation.

Under such circumstances, the procurement plan of equipment is made to deliver road maintenance equipment and assign each national road maintenance company.

(2) Necessity and Basis of Quantity to Procure Equipment

The following steps are made to determine specification and quantity of equipment.

1) Selection of Targeted Roads

The Ministry of Road, Transport and Tourism has a plan to distribute equipment to two national road maintenance companies of AZZA Tuv and HARGUI. In order to select the model and quantity of equipment to be procured, items and volume of works are estimated for each national road maintenance company.

Maintenance and repair on Provincial road that strong request from local people is made are also included in the range of targeted road, and accordingly paved section of Eastern Arterial Road as well as unpaved gravel roads are included.

The work schedule of Eastern Arterial Road construction and maintenance management is shown in Table 2-2-2-18. The targeted roads which perform maintenance management using equipment delivered to each maintenance company are summarized in Table 2-2-2-19.

Table 2-2-2-18 Work Schedule of Eastern Arterial Road Construction and Maintenance Management

Items		2004	2005	2006	2007	2008	2009	Note
Eastern Arterial Road	Newly construction (222km)	DOR						
	Rehabilitation of existing road (105.7km)							
	Maintenance works (330km)							Need constant maintenance
City existing paved road	nalayha～Terergi (29km)							
	Bganur words (2.5km)							
	Undurkhan (7.5km)							
Principal prefectural road, Gravel road, Earth road	UB～Terelgi (29km)							
	Baganur Ward gel area road (10km)							
	Undurhan～Norovlin (20km)							
	Undurhan～Choybalsan (20km)							
	Undurhan～Baruun-Urt (20km)							

Note) Calendar year and month expressed in the table are tentative only.

Table 2-2-2-19 Targeted Roads of each Maintenance Company using Equipment Supplied

Maintenance company	Road	Section	length (km)	Road type
AZZA Tuv	Eastern Arterial Road	UB～Kherlen Bridge	52.7	Paved (Improvement)
		UB～Bayan pass	13.3	Rock Asphalt (Maintenance)
		Erdene～I.S at Baganuur	53	Paved (Include Section II Improvement)
		I.S at Baganuur～Kherlen Bridge	16	Paved (New Construction)
	Baganuur City Road	Nalayha～Terergi	29	Paved (Improvement)
		Baganuur ward road	2.5	Paved (Improvement)
		Baganuur gel area road	10	Improved earth road (Improvement)
		Baganuur peripheral road	29	Improved earth road (Improvement)
HARGUI	Eastern Arterial Road	Kherlen bridge～Undrukhaan	199	Paved
	Principal Provincial Road	Kherlen bridge～Undrukhaan	7.5	Paved (Improvement)
		Undrukhaan peripheral road	60	Improved earth road (Improvement)

2) Selection of Equipment

There are following three types of work for the targeted roads as a maintenance management work.

A : Maintenance management work of paved roads such as repair of pothole, cracks, etc.

B : Repair of paved roads such as reconstruction of pavement surface, overlay, etc.

C : Repair of unpaved roads such as grading, leveling, etc.

The work teams required for the work of three types was set up, and the equipment composition which is necessary minimum for each team in consideration of the contents of the past project in Mongolia was set up.

About the amount of annual maintenance management work of an eastern part trunk road, maintenance management of a paved road is estimated about 2% to all extension in the maintenance management plan of the former DOR. The number of required teams was estimated by having measured this amount of work, the construction capability by the combination of the standard equipment to each work, and the annual team work capability to be considered from the annual workable days. Road repairing in a severe winter term is very difficult. Since especially an asphalt mixture quality control is difficult, construction period is limited from May to September. Considering these site conditions, the annual working days, the daily and annual work capability of each team are estimated in Table 2-2-2-20.

Table 2-2-2-20 Equipment Composition and Annual Work Volume

Team	Equipment	Q'ty	Work volume / day (m^2/day)	Working days /year	Work volume / year (m^2/year) (km/tear)
Road Maintenance Team for Paved Road	Asphalt Cutter	1	140	80	11,200 (1.4)
	Backhoe Loader	1			
	Road Maintenance Truck	1			
	Plate Compactor	1			
	Vibratory Rammer	1			
	Pick-Up Truck	1			
Road Improvement Team for Paved Road	Asphalt Cutter	1	450	80	36,000 (4.5)
	Backhoe Loader	1			
	Dump Truck	2			
	Asphalt Finisher	1			
	Vibration Roller	1			
	Line Marker	1			
	Asphalt Sprayer	1			
	Pick-Up Truck	1			
Road Improvement Team For Unpaved Road	Motor Grader	1	2,900	140	406,000 (50.5km)
	backhoe Loader	1			
	Dump Truck	1			
	Water Tanker	1			
	Vibration Roller	1			
	Vibratory Rammer	1			
	Pick-Up Truck	1			

The number of teams required for each maintenance company was calculated from the amount of annual work of each team, and the amount of annual work of each maintenance company.

Table 2-2-2-21 Required Number of Teams for Each Maintenance Company

maintenance company	Road	length (km)	Work	Annual work length（km） (ratio)（%）	Teams required
AZZA Tuv	Eastern Arterial Road	135	Maintenance for Paved Road	2.8 (2.1)	2
			Improvement for Paved Road	4.5 (3.3)	1
	Principal provincial road	39	Improvement for Unpaved Road	50.5	1
		31.5	Improvement for Paved Road		
HARGUI	Eastern Arterial Road	191	Maintenance for Paved Road	4.2 (2.2)	3
			Improvement for Paved Road	4.5 (2,4)	1
	Principal provincial road	60	Improvement for Unpaved Road	50.5	1
		7.5	Improvement for Paved Road		

Equipment that is shared by team for each work is shown in Table 2-2-2-22.

Table 2-2-2-22 Equipment to be shared by Team

Company	Equipment	Specification	Q'ty	Application
AZZA Tuv	Asphalt Plant	30 ton / hr	1	Production of asphalt mixture
	Crusher Plant	30 ton / hr	1	Production of aggregate
	Wheel Loader	2.3m^3	2	Loading materials at borrow site and Handling materials at plant yards
	Cargo Truck with crane	4ton with crane	1	Transport materials and Repairing of equipment at sites
	Asphalt testing equipment		1	Quality control of asphalt mixture
HARGUI	Asphalt Plant	30 ton / hr	1	Production of asphalt mixture
	Crusher Plant	30 ton / hr	1	Production of aggregate
	Wheel Loader	2.3m^3	2	Loading materials at borrow site and Handling materials at plant yards
	Cargo Truck with crane	4ton with crane	1	Transport materials and Repairing of equipment at sites
	Trailer	20t	1	Transport of equipment
	Asphalt testing equipment		1	Quality control of asphalt mixture

Required quantity of equipment is estimated from the above-mentioned equipment composition and the number of work teams. Furthermore, in consideration of accommodation between teams, the following equipment adjusts the calculated quantity.

a) Backhoe loader

Since each team will manage to work accommodating a backhoe loader among teams, one set is deducted from the required quantity of each company.

b) Pickup truck

One set was substituted for a cargo track with a crane for enhancing maintenance management ability of equipment for each company. A generator with welding function, a air compressor, and tools for mechanic are also equipped, and accordingly it may work as a mobile workshop at the site. Moreover, a line marker etc. may be carried by the cargo truck as a transport vehicle between the sites.

3) Summary of Quantity of Equipment to be Procured

The summary is shown in Table 2-2-2-23 according to applying two packages scheme to the procurement plan of equipment. The quantity for each company is shown in Table 2-2-2-24 and Table 2-2-2-25.

Table 2-2-2-23 Summary of Equipment Procured

No	Equipment	Specification	Total Q'ty	1st Pack.	2nd Pack.	Remarks
1	Motor Grader	3.7m	2	-	2	
2	Vibration Roller	7t (Combined type)	4	-	4	
3	Asphalt Finisher	2.5-4m	2	-	2	
4	Asphalt Plant	30t/hr	2	2	-	
5	Water Tanker	8,000ℓ	2	-	2	
6	Crusher Plant	30t/hr	2	2	-	
7	Asphalt Cutter	30cm	7	-	7	
8	Plate Compactor	80kg	5	-	5	
9	Pick-Up Truck	4×4,double cab	7	-	7	
10	Cargo Truck with crane	4ton with crane	2	-	2	Transport materials and Repairing of equipment at sites
11	Line Marker	15cm	2	-	2	
12	Asphalt testing equipment		2	2	-	
13	Backhoe Loader	75kw	7	-	7	
14	Road Maintenance Truck	4t	5	-	5	
15	Vibratory Rammer	70kg	7	-	7	
16	Dump Truck	15t	6	-	6	
17	Wheel Loader	$2.3m^3$	4	-	4	
18	Trailer	20t	1	-	1	
19	Asphalt Sprayer	400ℓ	2	-	2	

Table 2-2-2-24 Equipment Plan for AZZA Tuv

No	Equipment	Team			Common	Existing	Required
		2-Road Maintenance Teams for Paved Road	1-Road Improvement Team For Paved Road	1-Road Improvement Team For Unpaved Road			
1	Motor Grader			1			1
2	Vibration Roller		1	1			2
3	Asphalt Finisher		1				1
4	Asphalt Plant				1		1
5	Water Tanker			1			1
6	Crusher Plant				1		1
7	Asphalt Cutter	2	1				3
8	Plate Compactor	2					2
9	Pick-Up Truck	2	1	1			3(-1)
10	Cargo Truck with crane				1		1
11	Line Marker		1				1
12	Asphalt testing equipment				1		1
13	Backhoe Loader	2	1	1			3(-1)
14	Road Maintenance Truck	2					2
15	Vibratory Rammer	2		1			3
16	Dump Truck		2	1			3
17	Wheel Loader				2		2
18	Trailer						0
19	Asphalt Sprayer		1				1

Notes: The quantity in ( ) is the quantity reduced in consideration of accommodation between teams.

Table 2-2-2-25 Equipment Plan for HARGUI

No	Equipment	Team			Common	Existing	Required
		2-Road Maintenance Teams for Paved Road	1-Road Improvement Team For Paved Road	1-Road Improvement Team For Unpaved Road			
1	Motor Grader			1			1
2	Vibration Roller		1	1			2
3	Asphalt Finisher		1				1
4	Asphalt Plant				1		1
5	Water Tanker			1			1
6	Crusher Plant				1		1
7	Asphalt Cutter	3	1				4
8	Plate Compactor	3					3
9	Pick-Up Truck	3	1	1			4(-1)
10	Cargo Truck with crane				1		1
11	Line Marker		1				1
12	Asphalt testing equipment				1		1
13	Backhoe Loader	3	1	1			4(-1)
14	Road Maintenance Truck	3					3
15	Vibratory Rammer	3		1			4
16	Dump Truck		2	1			3
17	Wheel Loader				2		2
18	Trailer				1		1
19	Asphalt Sprayer		1				1

Notes: The quantity in ( ) is the quantity reduced in consideration of accommodation between teams.

4) Specification of Procured Equipment

The following specifications are deliberated by the study team.

a) Motor Grader: 3.7m class

Motor grader is used mainly for leveling surface such as finishing base course, leveling gravel road, etc. It can also finish slopes and repair side ditch by using the grading blade specifically for maintenance work. Since repair of unpaved roads linked to Eastern Arterial Road is also included in the work schedule of maintenance management, these two works will be important items in the schedule. The existing motor graders in two recipient companies, AZZA Tuv and HARGUI, are too old and obsolete to continue the maintenance work. Both companies will receive one set each in 2nd package.

b) Vibratory Roller: 7t, combined type

Mongolian side requested both large-scale vibratory roller and tire roller in the application form. However, the combination of these two rollers is not optimum selection for the work. First of all, although the asphalt repair work on small area will be the main work item, large-scale vibratory roller is too big to complete the work and is inefficient. Tire roller is the only machine necessary for finishing the gravel or earth road surface. The study team concluded that the vibratory roller (combined type) will meet the needs of the work. This has a vibratory steel roller in the front and tire roller at the back and is capable to do both repairing asphalt pavement in small area and finishing unpaved road surface. 7 ton vibratory roller (combined type) will be suitable scale and both recipient companies will receive two sets each in 2nd package according to the work volume and their capacity.

c) Asphalt Finisher: 2.5-4m

Asphalt finisher is indispensable for large scale repairing work of asphalt pavement because it will spread the asphalt mixture and conduct the primary compaction simultaneously to finish the asphalt pavement surface. Both recipient companies do not hold this machine and will receive one set each in 2nd package.

d) Asphalt Plant: 30 t/hr

Asphalt plant is superior to produce large amount of asphalt mixture. Repaving and overlaying considerable area will be large scale work and it will be inefficient and inadequate to do the work without using the Asphalt Plant. Asphalt Plant consists of aggregate supply unit, asphalt supply unit, heating and drying unit, dust controller,

measuring and mixing unit, etc. Mongolian side requested the asphalt plant with capacity to produce 60t/h but 20t/h is the minimum requirement judging from the work. The study team proposes to procure 30t/h capacity asphalt plant considering the work efficiency. It includes a generator to improve the productivity because the recovery from power failure spends time and the power supply situation at the site is not stable for the plant to operate.

Both recipient companies do not own the plant and will receive one set each in 1st package. However, a Japanese contractor for the civil works may use without charge one set of asphalt plant for HARGUI. It is planned to install in Baganuur area in the first place for Section II and will be transferred to Murun area prior to the commencement of construction works in Section VI, and will be handed over to HARGUI finally.

e) Water Tanker: 8000ℓ

Water tanker will spray water for compacting base course to adjust optimum moisture content and preventing dust in the construction site. The existing one water tanker of HARGUI is old and obsolete and AZZA Tuv does not hold it. Both companies will receive a set each in 2nd package.

f) Crusher Plant: 30 t/hr

Crusher plant produces aggregate by crushing raw material taken from quarry. It consists of feeder, conveyor, crusher and vibrating screen, etc. Produced aggregate will turn into base course material, raw aggregate for asphalt mixture and fresh mixed concrete.

Mongolian side requested 60t/h capacity crusher plant but the study team proposes 30t/h capacity plant according to the requirement of the asphalt plant and requirements of aggregate in the maintenance and repair work. It includes a generator to improve the productivity because the recovery from power failure spends time and the power supply situation at the site is not stable for the plant to operate.

Both recipient companies do not own the plant and will receive one set each in 1st package. However, a Japanese contractor for the civil works of Project may use without charge one set of crusher plant for HARGUI. It is planned to install in Baganuur area in the first place for Section II and will be handed over to HARGUI finally.

g) Asphalt Cutter: 30cm

Asphalt cutter cute the asphalt pavement to strip damaged surface from base course. It will improve efficiency of pothole repair works or repaving work at small area. Both

recipient companies do not have it and will receive several sets in 2nd package according to the work volume.

h) Vibrating Plate Compactor: 80kg

Vibrating plate compactor is small and handy equipment which compacts road surface. It compacts the edge and corner surface easily, so it is very convenient and improves the small scale paving works. It consists of plate, engine and vibrating unit. Both recipient companies do not have it and will receive several sets in 2nd package according to the work volume.

i) Pickup Truck: 4x4 double cab

Pick up truck will transfer workers, materials and small equipment from office to the site and will be utilize for investigation, repair and reconstruction works. Both recipient companies will receive several sets in 2nd package and number for procurement is set from the work volume. One truck was reduced from the list because both recipient companies will be able to utilize a cargo truck with crane (see next clause for details) as a transportation method. Every pickup truck will equip minimum set of tools for mechanics to perform minimum maintenance works at the site.

j) Cargo Truck (4t) with crane

Cargo truck was meant to be utilized for transportation of equipment and materials in the application form but the study team proposes the multi-use of transportation and service vehicle. It will equip 2.9t load capacity crane, welding machine with generator, air compressor and a set of tools. These add-on instruments enable cargo truck to maintenance and repair of equipment at the site. Both recipient companies do not have it and will receive a set in 2nd package as replacement of a pickup truck.

k) Line Marker: 15cm wide

Line marker marks the centerline, edge pavement making, stop lines and cross walks etc. Mongolian side requested line maker loaded onto truck that is necessary but the study team proposes handy type line marker because the operation rate will be very few in the maintenance work. The larger line marker is for large scale construction or quick repair with heavy traffic, which is not included in the work. Both recipient companies will receive a set in 2nd package considering low operation rate.

l) Asphalt Testing Equipment

It is indispensable for quality control for the asphalt plant. Since there is no equivalent facility in the site, both recipient companies will need to have an ability to control quality of asphalt mixture which is produced by procured asphalt plant. Both recipient companies will receive minimum testing equipment avoiding duplication with the existing equipment in 1st package. However, a Japanese contractor for the civil works may use without charge one set of asphalt testing equipment for HARGUI.

m) Backhoe Loader: 75kw

Backhoe loader is multi-use equipment with loader on front and backhoe at the back. It can break pavement with additional hydraulic breaker on the rear and load stripped surface to dump truck by loader or backhoe. It is suitable to any small scale excavating and loading works. All work items require this machine so AZZA Tuv and HARGUI will receive four and three respectively in 2nd package. One loader was reduced from the calculated required number because the procured loaders can be shared among maintenance teams.

n) Road Maintenance Truck: 4t

Road maintenance truck is multipurpose truck for small scale asphalt pavement repair works. It consists of asphalt tank, water tank, heating system, burner, air compressor, dump vessel, asphalt sprayer and a set of basic tools. It was procured in the project of "Improvement of Road in Ulaanbaatar" by Japanese Government and well utilized. The proposed specification is equivalent to the above mentioned project. AZZA Tuv and HARGUI will receive two and three respectively in 2nd package.

o) Vibratory Rammer: 70kg

Vibratory rammer compacts small area of surface by its weight. It hops itself up by using engine and spring and strikes the surface by plate. This kind of striking compaction work is useful for gravel compaction. AZZA Tuv and HARGUI will receive three and four respectively in 2nd package.

p) Dump Truck: 15t

Dump truck carries raw materials from quarry to plant and asphalt mixture and base course material from plant to site. Since the existing trucks of two recipient companies are old and obsolete, they will receive 15t class dump trucks. Both AZZA Tuv and HARGUI will receive three trucks in 2nd package.

q) Wheel Loader: 2.3m^3

Wheel loader loads raw materials to dump truck at the quarry, aggregates to dump truck from crusher plant to asphalt plant, concrete batcher plant, and site as base course material. Since two recipient companies have not wheel loaders, both AZZA Tuv and HARGUI will receive one each in 2nd package for a quarry and a plant yard.

r) Trailer: 20 t

Trailer will carry heavy equipment from garage to site or site to site. Equipment will have to move very frequently because the maintenance and repair works are tend to be small scale. AZZA Tuv will be able to procure from Ulaanbaatar when needed since Baganuur area is approximately 100km from the capital. HARGUI will have difficulties since Undurkhaan is about 300km away from Ulaanbaatar. Loading capacity needs 20 ton since motor grader of 14 ton is heaviest equipment and considering the existing road condition of Undurkhann surroundings, 6t of margin is proposed. HARGUI will receive a set in 2nd package.

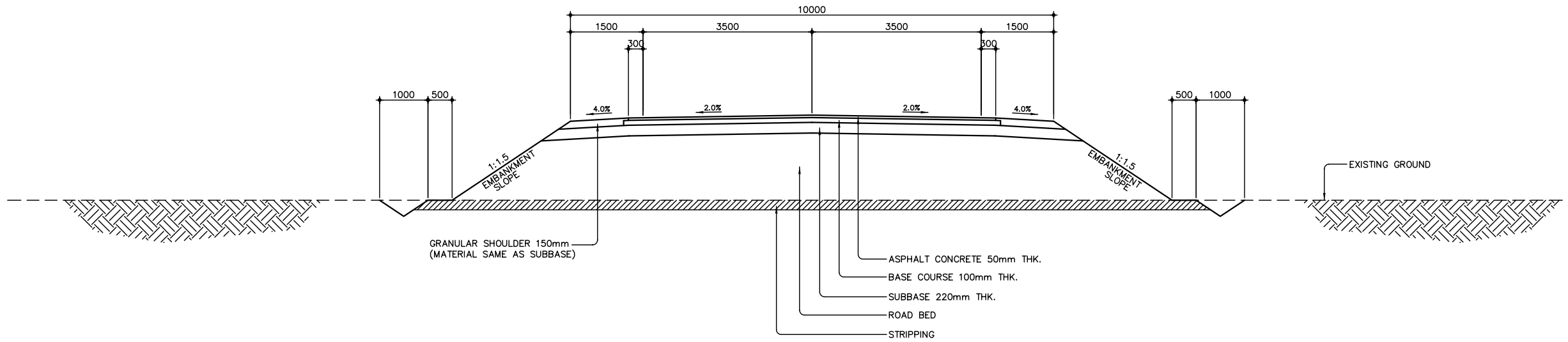
s) Asphalt Sprayer: 400ℓ

Asphalt sprayer will spray asphalt emulsion on base course to secure adhesion between base course and surface course. Application requests 1,500 liter of capacity, but study team proposes 400 liter judging from the work volume. Both recipient companies do not have this equipment and will receive a set each in 2nd package.

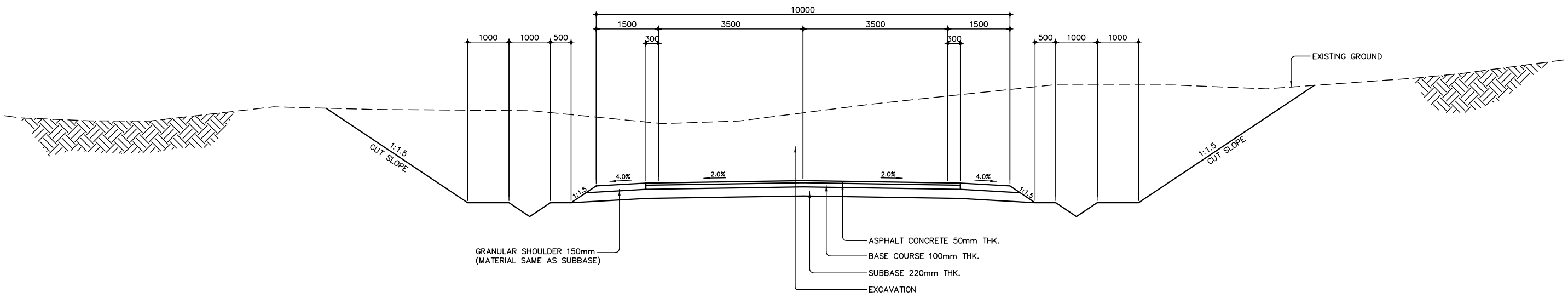
2-2-3 Basic Design Drawing

The following drawings are attached as basic design drawings.

- Plan
- Profile
- Typical cross section
- General view of bridge
- General view of box culvert
- General view of pipe culvert
- Others



2 B-3 **SECTION FILL**
SCALE 1:50



1 B-3 **SECTION IN CUT**
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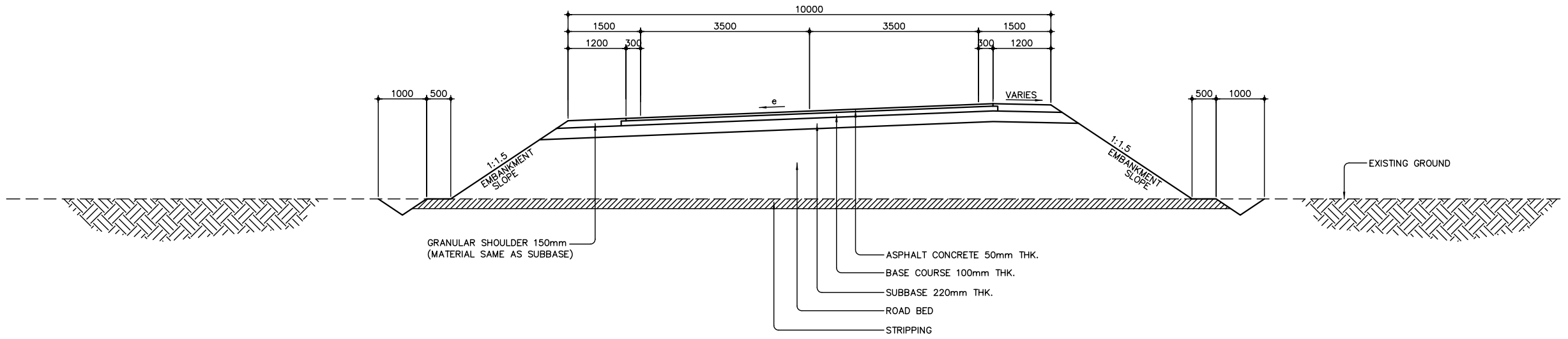
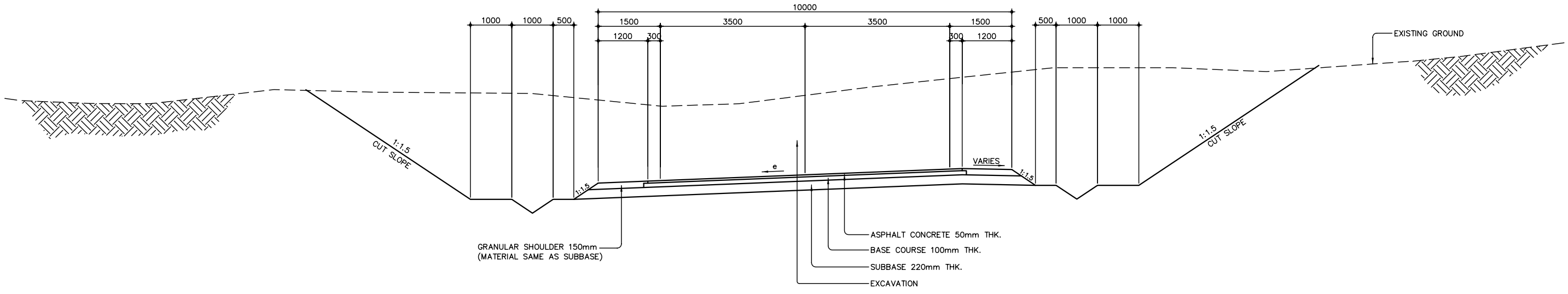
Figure 2-2-3-1 Typical Roadway Section (1) (Section II New Construction)

THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA		
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DEPARTMENT OF ROADS, MINISTRY OF INFRASTRUCTURE, THE GOVERNMENT OF MONGOLIA	
PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS		
Drawing title	Scale	Sheet No.
TYPICAL ROADWAY SECTION (1) (STAGE-1)	AS SHOWN	B-3 (3 | 4)



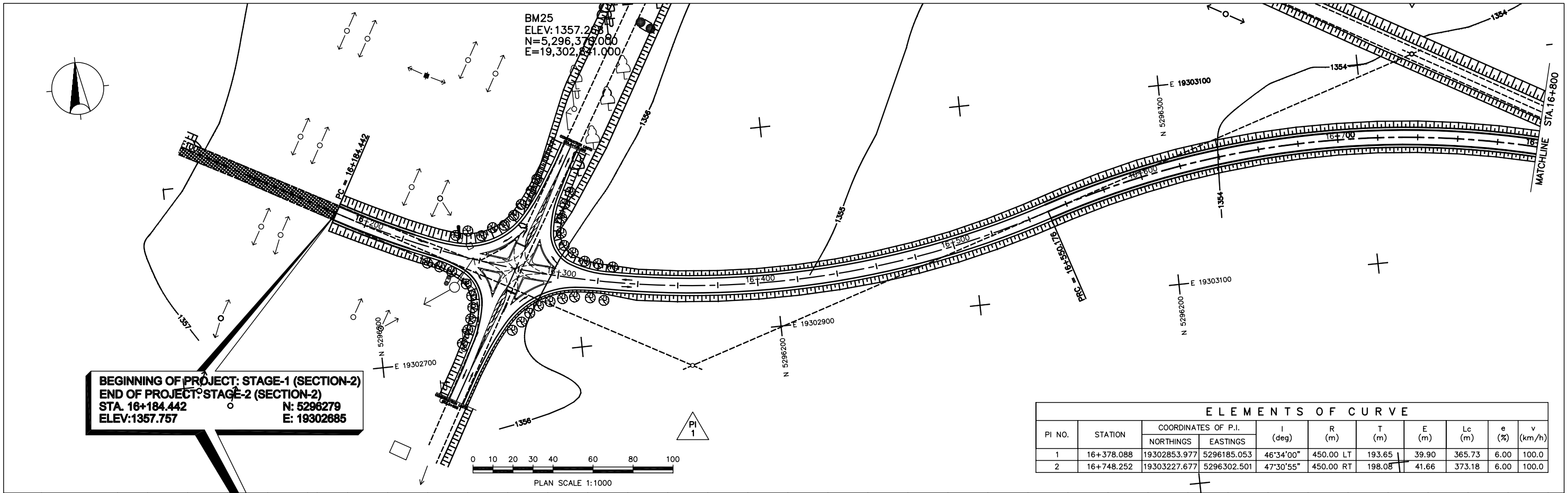
2 / B-4 SUPERELEVATED SECTION IN FILL
SCALE 1:50



1 / B-4 SUPERELEVATED SECTION IN CUT
SCALE 1:50

Figure 2-2-3-2 Typical Roadway Section (2) (Section II New Construction)

THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA		
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DEPARTMENT OF ROADS, MINISTRY OF INFRASTRUCTURE, THE GOVERNMENT OF MONGOLIA	
PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS		
Drawing title	Scale	Sheet No.
TYPICAL ROADWAY SECTION (2) (STAGE-1)	AS SHOWN	B-4 4 | 4



ELEMENTS OF CURVE										
PI NO.	STATION	COORDINATES OF P.I.		I (deg)	R (m)	T (m)	E (m)	Lc (m)	e (%)	v (km/h)
		NORTHINGS	EASTINGS							
1	16+378.088	19302853.977	5296185.053	46°34'00"	450.00 LT	193.65	39.90	365.73	6.00	100.0
2	16+748.252	19303227.677	5296302.501	47°30'55"	450.00 RT	198.08	41.66	373.18	6.00	100.0

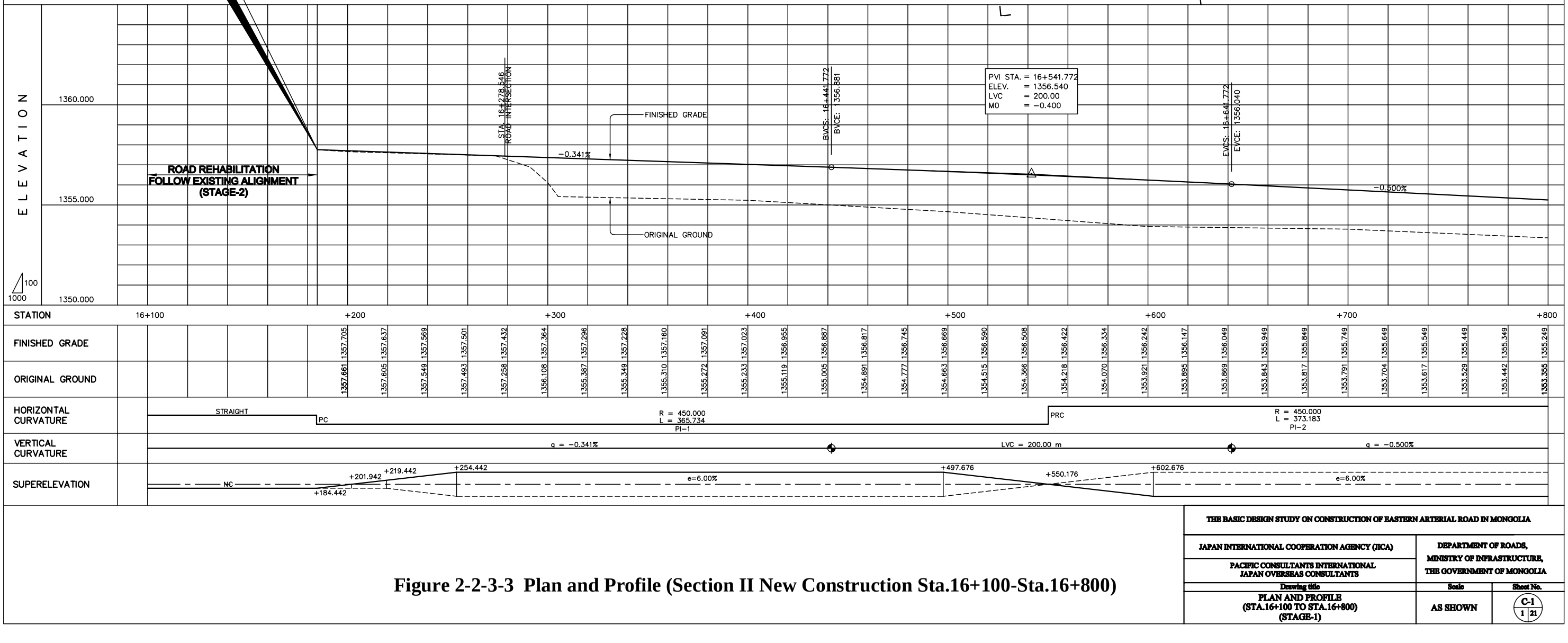
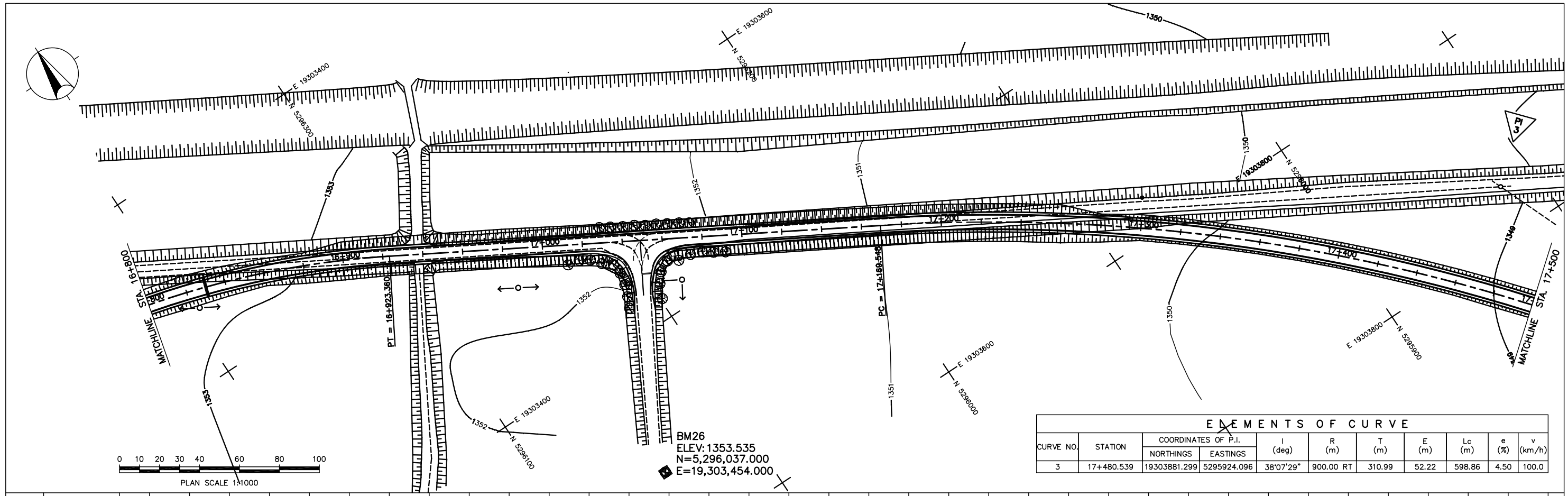
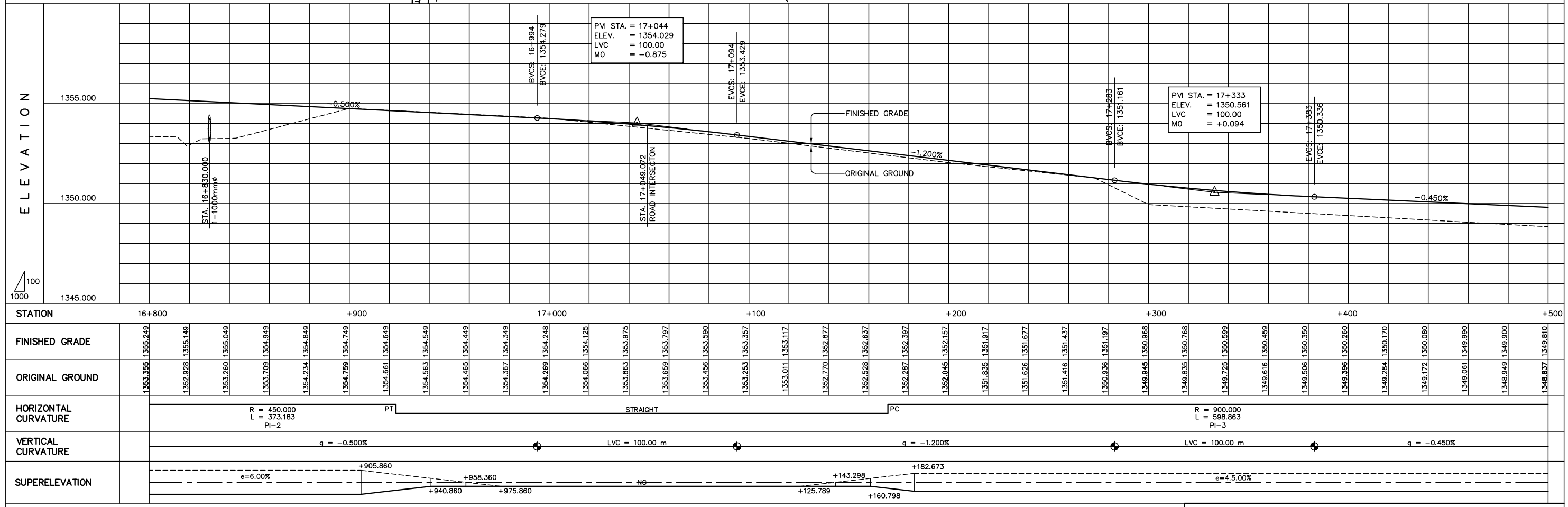


Figure 2-2-3-3 Plan and Profile (Section II New Construction Sta.16+100-Sta.16+800)

THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DEPARTMENT OF ROADS, MINISTRY OF INFRASTRUCTURE, THE GOVERNMENT OF MONGOLIA
PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS	
Drawing title	Scale / Sheet No.
PLAN AND PROFILE (STA.16+100 TO STA.16+800) (STAGE-1)	AS SHOWN / C-1 (1 | 21)

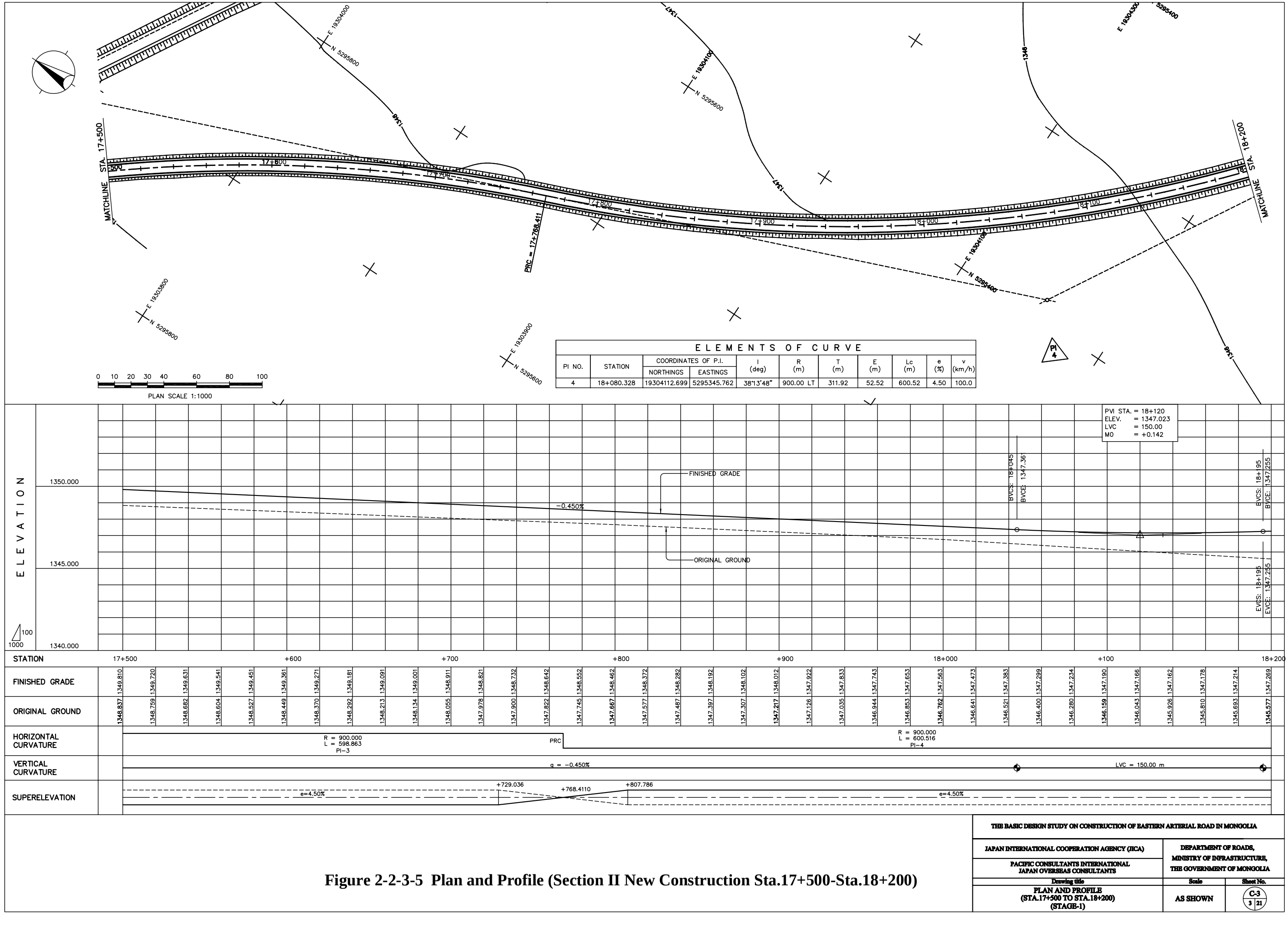


ELEMENTS OF CURVE										
CURVE NO.	STATION	COORDINATES OF P.I.		I (deg)	R (m)	T (m)	E (m)	Lc (m)	e (%)	v (km/h)
		NORTHINGS	EASTINGS							
3	17+480.539	19303881.299	5295924.096	38°07'29"	900.00 RT	310.99	52.22	598.86	4.50	100.0



THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	DEPARTMENT OF ROADS, MINISTRY OF INFRASTRUCTURE, THE GOVERNMENT OF MONGOLIA
PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS	
Drawing title	Scale / Sheet No.
PLAN AND PROFILE (STA.16+800 TO STA.17+500) (STAGE-1)	AS SHOWN / C-2 2 21

Figure 2-2-3-4 Plan and Profile (Section II New Construction Sta.16+800-Sta.17+500)



ELEMENTS OF CURVE										
PI NO.	STATION	COORDINATES OF P.I.		I (deg)	R (m)	T (m)	E (m)	Lc (m)	e (%)	v (km/h)
		NORTHINGS	EASTINGS							
4	18+080.328	19304112.699	5295345.762	38°13'48"	900.00 LT	311.92	52.52	600.52	4.50	100.0

STATION	FINISHED GRADE	ORIGINAL GROUND
17+500	1349.810	1348.837
17+520	1349.720	1348.759
17+540	1349.631	1348.682
17+560	1349.541	1348.604
17+580	1349.451	1348.527
17+600	1349.361	1348.449
17+620	1349.271	1348.370
17+640	1349.181	1348.292
17+660	1349.091	1348.213
17+680	1349.001	1348.134
17+700	1348.911	1348.055
17+720	1348.821	1347.978
17+740	1348.732	1347.900
17+760	1348.642	1347.822
17+780	1348.552	1347.745
17+800	1348.462	1347.667
17+820	1348.372	1347.577
17+840	1348.282	1347.487
17+860	1348.192	1347.397
17+880	1348.102	1347.307
17+900	1348.012	1347.217
17+920	1347.922	1347.126
17+940	1347.833	1347.035
17+960	1347.743	1346.944
17+980	1347.653	1346.853
18+000	1347.563	1346.762
18+020	1347.473	1346.641
18+040	1347.383	1346.521
18+060	1347.299	1346.400
18+080	1347.234	1346.280
18+100	1347.190	1346.159
18+120	1347.166	1346.043
18+140	1347.162	1345.926
18+160	1347.178	1345.810
18+180	1347.214	1345.693
18+200	1347.269	1345.577

THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA

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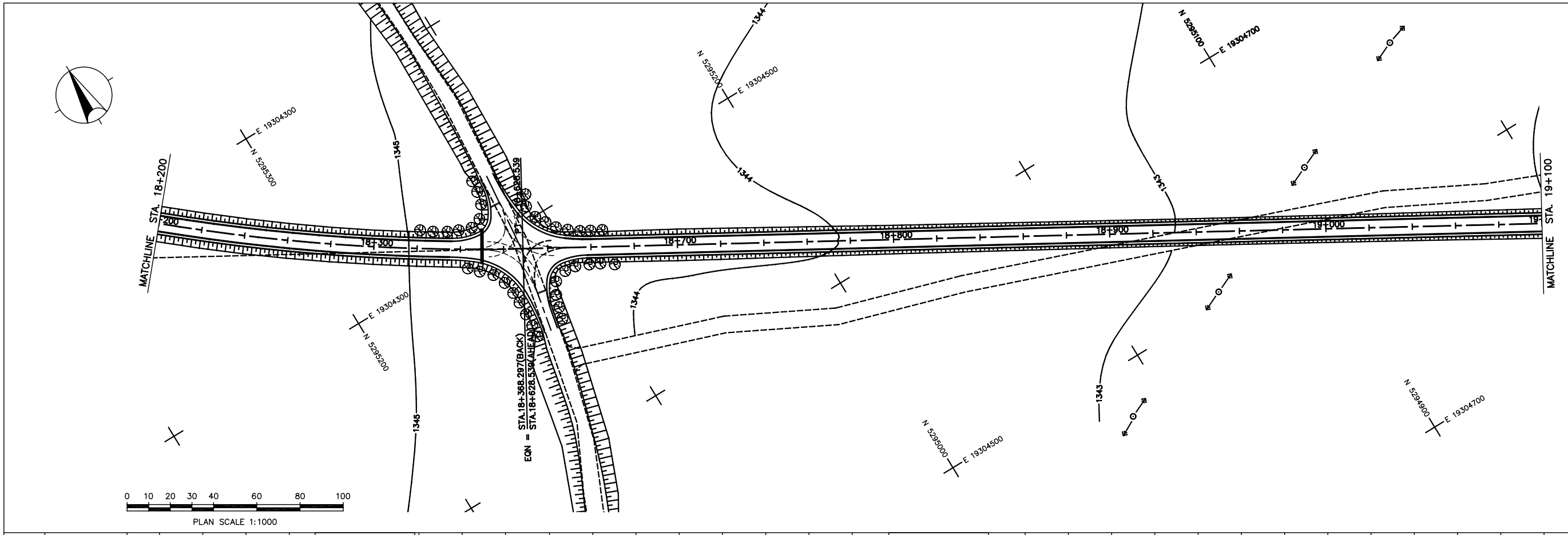
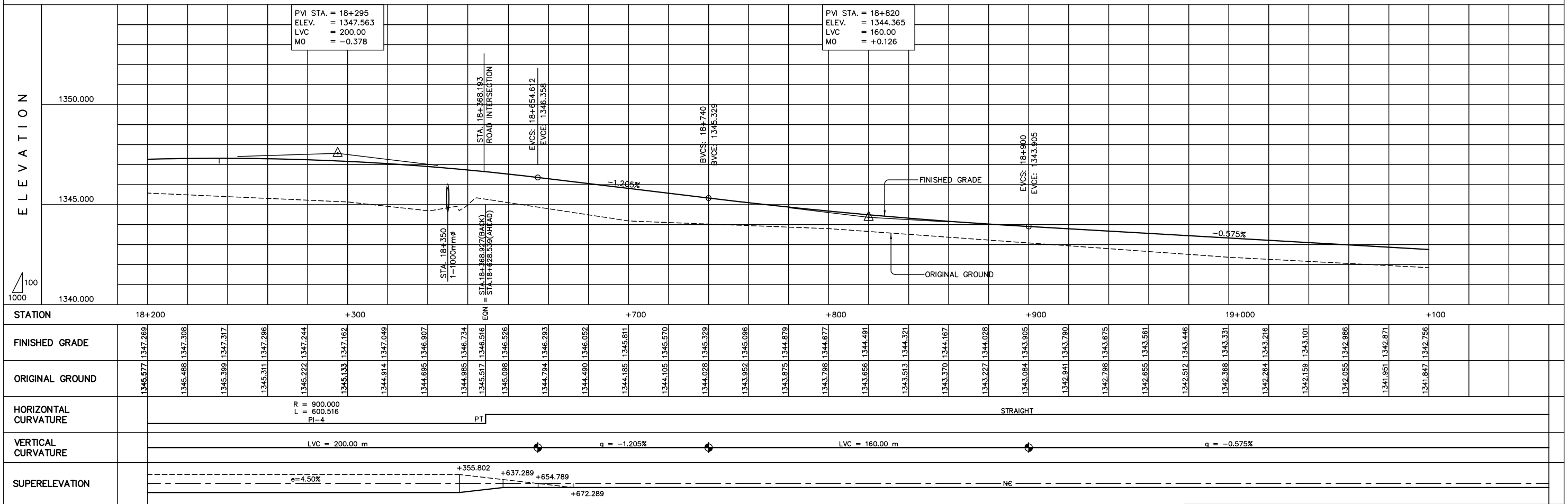
PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS		
Drawing title	Scale	Sheet No.
PLAN AND PROFILE (STA.17+500 TO STA.18+200) (STAGE-1)	AS SHOWN	C-3 (3 | 21)

Figure 2-2-3-5 Plan and Profile (Section II New Construction Sta.17+500-Sta.18+200)





THE BASIC DESIGN STUDY ON CONSTRUCTION OF EASTERN ARTERIAL ROAD IN MONGOLIA	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) PACIFIC CONSULTANTS INTERNATIONAL JAPAN OVERSEAS CONSULTANTS	DEPARTMENT OF ROADS, MINISTRY OF INFRASTRUCTURE, THE GOVERNMENT OF MONGOLIA
Drawing title: PLAN AND PROFILE (STA.18+200 TO STA.19+100) (STAGE-1)	Scale: AS SHOWN Sheet No.: C-4 (4 / 21)

Figure 2-2-3-6 Plan and Profile (Section II New Construction Sta.18+200-Sta.19+100)