B) Character of Consistency

The objective of the test is to classify soil with particle size gradation. The character of consistency is summarized in Table 4.3, and is shown Annex Figure 8.1.

- No change of consistency is observed with increasing depth below the ground surface.
- According to the consistency chart, cohesive deposit is to be classified into ML or OL.
- Alluvium cohesive soil is classified as being in an unstable condition as WL = Wn, Ic = -0.55 ~ 0.77, Ic = 0.11.

Table 4.3 Results of Consistency

Deposit	Items of Consistency						
	Wn (%)	Wl (%)	Ip	If	It	Ic	Activity Ratio
	Average Value	Average Value	Average Value	Average Value	Average Value	Average Value	Average Value
	Represen -tative Range	Represen -tative Range	Represen -tative Range	Represen -tative Range	Represen -tative Range	Represen -tative Range	Represen -tative Range
Cohesive soil	38.6	40.8	12.4	–	–	0.11	–
	30.8 ~ 46.9	34.3 ~ 45.1	8.3 ~ 16.5	–	–	-0.55 ~ 0.77	–

Note:
CH: High plasticity and cohesive clay with non organic
OH: Organic clay with medium plasticity
MH: Non-organic silt, micaceous or diatomaceous fine sandy/silt soils and elastic silts
CL: Low to medium plasticity silt, clay with sand or gravel, and low cohesive clay
Wn: Natural water content
WL: Liquid limit
Ip: Plasticity index
If: Flow index
It: Toughness index (It = Ip/If)
A degree of shear strength at plastic limit
Ic: Consistency index (Toughness and stability of cohesive soil)
Ic = (WL - Wn)/Ip
Ic ≥ 1 Stable condition
Ic = 0 Unstable condition: Liquidize by disturbance

C) Specific Gravity

The test results yield reasonable values with a standard deviation of 0.069 ~ 0.099.

Table 4.4 Result of G_s

	Items of Soil Properties
	Specific Gravity G_s
	Average Value
	Representative Range
Sandy soil (West area)	2.740
	2.671 ~ 2.809
Sandy soil (East area)	2.696
	2.581 ~ 2.811
Cohesive soil	2.644
	2.545 ~ 2.743

Note: Typical value of soils
Sand, sandy gravel or sandy soil $G_s = 2.65 \sim 2.75$
Clay or cohesive soil $G_s = 2.60 \sim 2.70$

(4) Foundation Strata for Structural Design

A) Criteria and Distribution of Bearing Strata

The load bearing strata for structures is assessed depending on importance of the structure and the longitudinal forces to be carried by the structure.

In general, the criteria for spread or piled foundations of bridge abutments and piers is defined as the following N-values:

Sandy Soil	$N > 30$
Cohesive soil	$N > 20$

Results of soil investigation, the depth of bearing strata of the above N-values and more than 50 are shown as Table 4.5.

Table 4.5 Bearing Strata for Structural Design

Site	Bearing Strata			
	N-value more than 20 (c), 30 (s)		N-value more than 50	
	Depth (Elevation)	Soil Bed	Depth (Elevation)	Soil Bed
Alligator Creek	31 ~ 35 (-29 ~ -32)	Sandy soil	46 (-43)	Sandy soil
Metapono River	–	–	25 (-5)	Sandy silt
White River	25 (-22)	Coral sandy gravel	30 (-26 ~ -27)	Coral limestone
Mbonege River	11 ~ 15 (-9 ~ -11)	Sandy soil	16 ~ 19 (-13 ~ -17)	Sandy soil
Tanaemba River	22 ~ 24 (-22 ~ -23)	Sandy soil	27 (-19 ~ -21)	Sandy soil

B) Soil Values of Bearing Strata

Soil values to decide the bearing strata for structures are summarized in Table 4.6.

Table 4.6 Soil Values of Bearing Strata

Division of Soil	Wet Density γt (t/m^3)	Cohesion of the First Stage c (t/m^2)	Internal Friction Angle ø (Degree)	Modulus of Elasticity Eo (kg/cm^2)
Cohesive soil	Table 4.7	0.625N	–	28N
Sandy soil	Table 4.7	–	Fig. 4.1	–

Note: N-value and ground water level are shown in the soil profile.

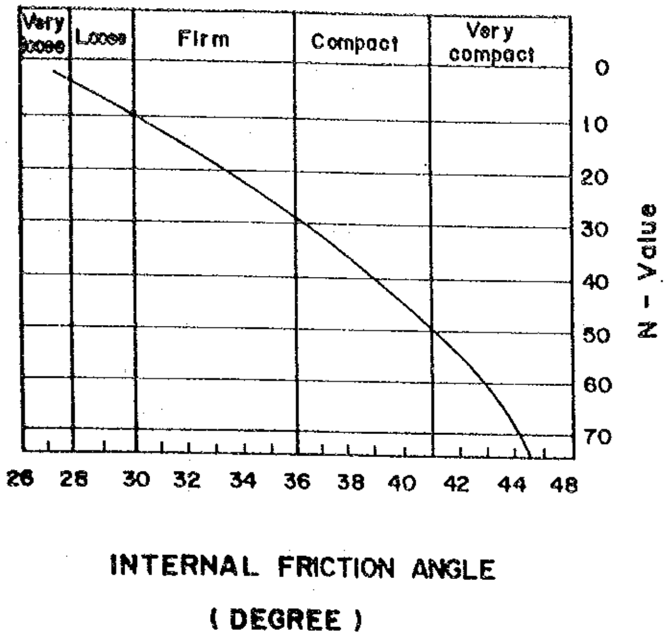


Fig. 4.1 Relative Chart for N-Value and Internal Friction Angle

Table 4.7 Wet Density of Soil

Soil		Condition of Soil	Wet density (t/m^3)	Symbols
Embankment	Sand mixed gravel	Compact	2.0	GW, GP
	Sand	Compact – Good gradation	2.0	SW, SP
		Compact – No good gradation	1.9	
	Sandy soil	Compact	1.8	SM, SC
	Cohesive soil	Compact	1.7	ML, CL, (MH, CH)
	Volcanic cohesive soil	Compact	1.4	VH
Natural ground	Gravel	Compact or good gradation	2.0	GW, GP
		Loose or no good gradation	1.8	
	Sand mixed gravel	Compact	2.1	GW, GP
		Loose	1.9	
	Sand	Compact or good gradation	2.0	SW, SP
		Loose or no good gradation	1.8	
	Sandy soil	Compact	1.9	SM, SC
		Loose	1.7	
	Cohesive soil	Hard	1.8	ML, CL
		Soft	1.6	
	Silt	Hard	1.6	ML
		Soft	1.4	
	Clay	Hard	1.7	CH, MH
		Soft	1.5	
	Volcanic cohesive soil		1.4	VH

4.2.2 River Conditions

The rivers at the project sites are in general characterised by being very short with steep grades and rapid flows. A description of the rivers are given in Table 4.8. The White River has no retention pond in the upper reaches, and is of the ditch type of the urban community type. The Alligator Creek is a short creek with a small collection basin, there is sea water in the creek, and fills with drainage discharge from the airport only when it rains. The Tanaemba River has a waterway that has had many changes, and the present bridge site is in a corner which was formed by the main river channel shifting to this location, and there is a pipe culvert in a branch near the main waterway.

There is sand and gravel in the river beds, and the river waters are clear. There are no signs of logs having been floated down the rivers as can be seen at submerged bridges.

The flood water levels (1986 in recent years), have not reached the bridge beam levels according to hearings conducted in the field, and flood water levels calculated from the recorded data (planned rain probability: 50 years), the data given in Table 4.8 is obtained.

Table 4.8 River Data

River Name	Approx. Length of River (km)	Coll. Basin (km^2)	Collection Basin Area Q50 (m^3/sec)	Planned Flood Water Height (m)	Freeboard under Beam (m)*2
Alligator Creek	3	9	–	(2.50)	0.6
Metapono River	30	175	1,180	21.80	1.0
White River	10	11	100	3.10	0.6
Mbonege River	23	67	610	4.70	1.0
Tanaemba River	10	24	300	7.60	0.8

*1: From 8 Bridges on Guadalcanal, Solomon Islands, Design Report (1977, by Cameron, McNamara & Partners Pty Ltd.)
*2: Ministry of Construction, River Sands Technical Standards

4.2.3 Traffic Volume in the Study Area

A road traffic count was conducted at the places shown in the map in Fig. 4.2 on December 1, 1992 (Tues) for 12 hours (6:00 AM to 6:00 PM). The results are shown in Table 4.9.

Characteristics of the Traffic:

- Traffic is very heavy in the urban areas of Honiara, and falls off rapidly with the distance away from the city. Pedestrian traffic has the same trend.
- There are many heavy vehicles east of Honiara City between Alligator Creek and Tenaru River.

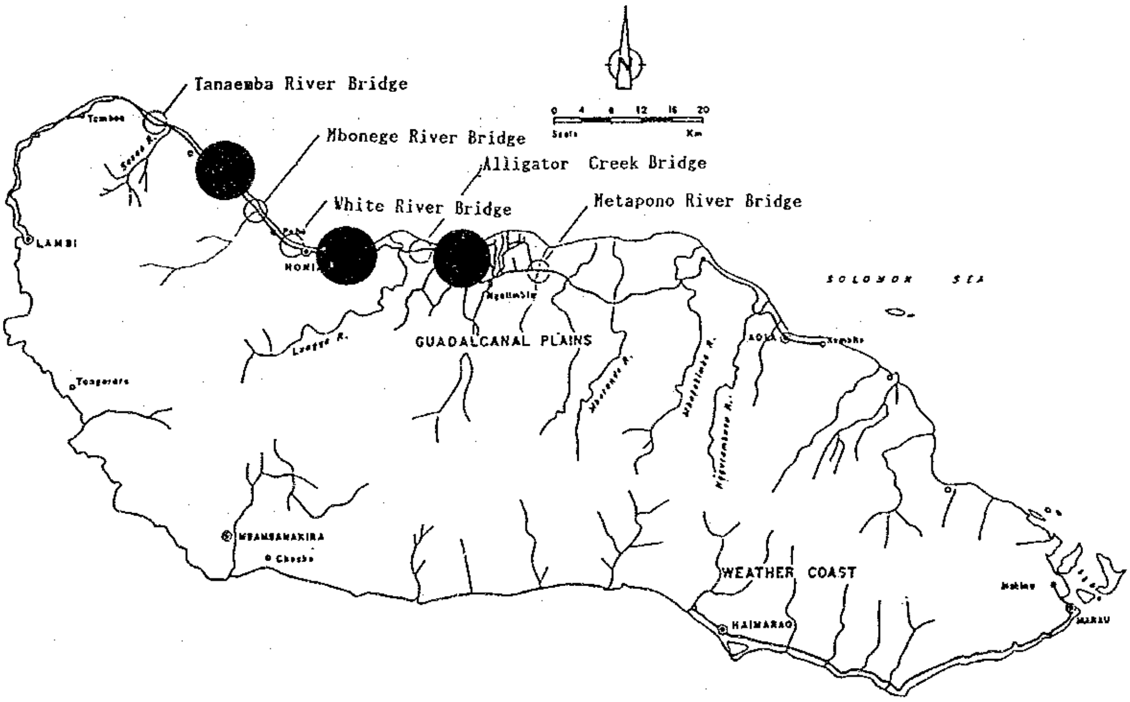


Fig. 4.2 Location Where Traffic Counts were Taken

Table 4.9 Result of Traffic Count Survey

Location	Motor-cycle	Passenger Car	Bus	Truck	Total	Bicycles & Pedestrians
Mbonege - Poha	4	207	6	97	314	45
White - Honiara	45	5,857	289	667	6,838	2,057
Alligator - Tenaru	27	860	18	221	1,126	99

Source: JICA Field Study

4.3 Study and Examination of Design Criteria

4.3.1 Design Criteria

The Basic Design Standards to be used for the Bridge Replacement Program was discussed with the Ministry of Transport, Works and Utilities (MTWU), and are as follows:

(1) Bridge Width:

a) Road Classification for Solomon Islands (IBRD)
b) Road Structures Law (Japan)

(2) Design Loads:

a) Road Bridge Standards (Japan)

(3) Seismic Loads:

a) Road Bridge Standards (Japan)

(4) Other Requirements:

When there are no suitable design standards for road bridges, the design standards of Japan will be used. The loads to be used for the design are the load frequencies, and for the influence on the bridges, the loads will consist of principal loads, subsidiary loads, and particular loads.

1) Principal Loads:

a) Dead Load
b) Live Load
c) Impact
d) Influence of creep on concrete
e) Influence of dry shrinkage on concrete
f) Earth pressures
g) Water pressures
h) Floatation or displacement forces

2) Subsidiary Loads:

In addition to dead loads and primary live loads, the bridge components will be designed to resist subsidiary loads, which include the following:

a) Wind loads
b) Influence of temperature change
c) Seismic loads

3) Particular Loads:

Loads used under special conditions are:

a) Influence of foundation changes
b) Influence of support movement
c) Brake load
d) Construction operation loads
e) Collision loads
f) Other loads

4) Dead Load:

Dead loads are the self weight of the bridge structure together with any added permanent external loads (water pipe, power or telephone cable).

Table 4.10 Unit Weight Per Unit Volume of Materials

Material	Specific Gravity	Material	Specific Gravity
Steel, Cast Steel, Forged Steel	7.850	Concrete, Non-reinforced	2.350
Cast Iron	7.250	Mortar, Portland Cement	2.150
Aluminum	2.800	Asphalt Pavement	2.300
Concrete, Reinforced	2.500	Concrete Pavement	2.350
Prestressed Concrete	2.500	Timber	0.800

The weight of added external materials are as follows:

- Cast iron water pipe, 260ø mm W= 160 kg/m
- Telephone cable, 90ø mm W= 30 kg/m
- Power cable, 150ø mm W= 30 kg/m

(Design data for use with concrete decks)

Carriageways:

T-loads will be acting on bridge roadways. T-loads will be acting on bridge components for the maximum stresses, and will be vehicle in the direction of the bridge axis, and will be acting regardless of the number of vehicles in the perpendicular direction of the bridge axle.

Table 4.11 Design Load T-20

Design Load	Gross Vehicle Weight (w)	Front Axle Weight 0.1w	Rear Axle Weight 0.4w	Front Wheel Width b2	Rear Wheel Width b2	Front Wheel Ground Contact Length a
T-20	20 (t)	2000 (kg)	8000 (kg)	12.5 (m)	50 (cm)	20 (cm)

Pedestrian Walkway:

The load on the pedestrian walkway will be people load of 350 kg/m^2 distributed load.

Design data to be used for main girder.

Carriageway:

L-load will be acting on the carriageway consisting of one line load and uniform load per bridge. L-load will be acting on bridge components for the maximum stress. 100% of L-load will be acting on 5.5m of carriageway and 50% of L-load on the remaining width of carriageway.

The design load will be the TL=20 case used in the Japanese specification.

5) Live Load:

The live load will be the vehicle load (T-load, L-load) together with the people load on the walkway.

4.3.2 Selection of Bridge Types

(1) Type of Applicable Bridges

Types of applicable bridges are divided into three types, namely, reinforced concrete bridges, prestressed concrete bridges and steel bridges.

General applicable range is shown in Fig. 4.3 "The Relations between the Bridge Types and Applicable Span Length".

The type of bridges that could be applied for this project will be one of the following based on the natural conditions, the planning conditions (bridge width, length, and the construction period).

a) Reinforced concrete T-beam bridge
b) Prestressed-concrete T-beam bridge
c) Steel beam bridge
d) Steel box girder bridge
e) Steel truss bridge

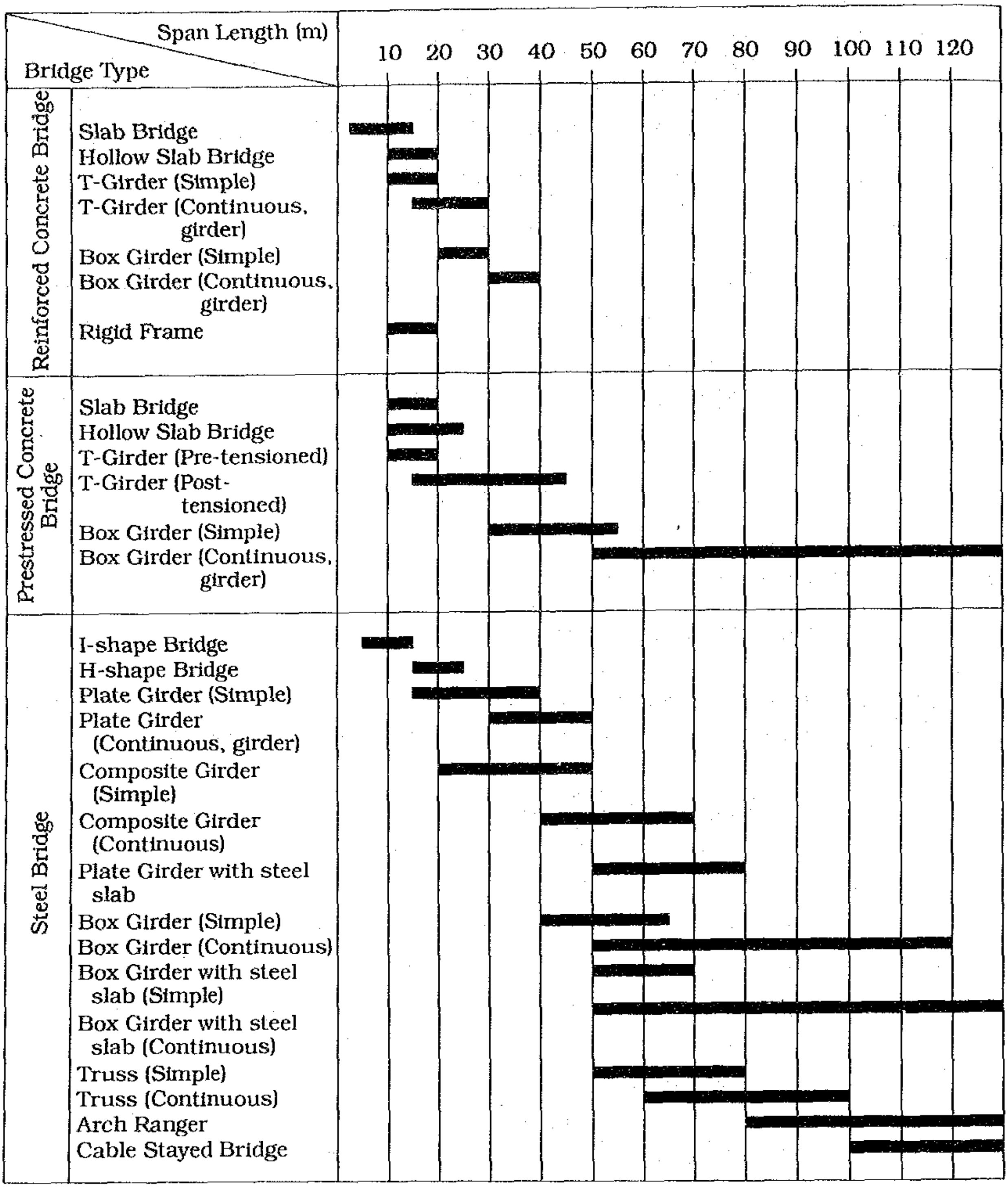


Fig. 4.3 The Relations between the Bridge Types and Applicable Span Length

Reinforced concrete T-beam bridge is favorable from the point of fabrication that the most of the materials could be procured locally, however, the strength of concrete can not be assured, and the weight of the structure could be large. The span of the bridge supports will be limited (10~15m).

For the prestressed-concrete bridge, it will be difficult to obtain concrete with a guaranteed strength requirement ($\sigma_{ck} \geq 350$ kg/m^2).

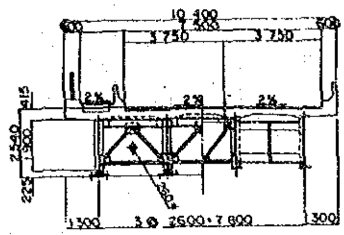
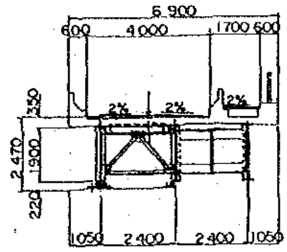
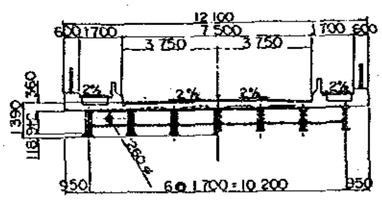
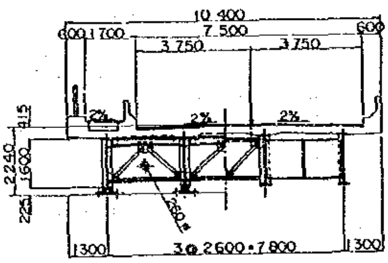
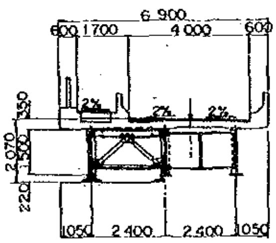
The steel girder for the steel girder bridge will have to be imported, however the desirable feature will be that the construction period could be fairly short and the dead loads could be lighter. The span of the bridge supports for steel box-girder bridges and steel truss bridges could be larger (on the order of 50~70m). The steel requirements would become larger with increase in costs, and the loads on the supports could be larger.

The advantages and disadvantages of the various bridge types are as described in the above, and the final bridge type selection would be decided after analysis of the various types.

(2) Bridge Width

The bridge width will be determined after a study of the road traffic count has been completed, consideration of the development trends, and the socio-economic conditions have been evaluated. The classification of the roads for the Solomon Islands have been shown in the request paper and this standard will be taken into consideration and Table 4.12 has been prepared for the bridge width.

Table 4.12 Bridge Width

Bridge Name	Description	Width Make-Up
1. Alligator Creek Bridge	– East of Honiara City, near airport, and road traffic is heavy. Pedestrian traffic is light.	
2. Metapono River Bridge	– Approx. 30 km east of Honiara City, and road traffic is light. Heavy vehicle traffic is comparatively heavy. – Ngalimbiu River Bridge on Honiara City side of this bridge is permanent construction. Bridge is one-lane width without pedestrian walkway. – New Bridge is to be one-lane with pedestrian walkway one side.	
3. White River Bridge	– In Honiara City with heavy road and pedestrian traffic. – Roadway from this bridge to Honiara Airport is under construction to 2-lane and with median. – Bridge width shown in Fig. 4.2 with 2-lane road and pedestrian walkway both sides.	
4. Mbonege River Bridge	– Poha Bridge (culvert) on Honiara side of this bridge will be 2-lane. (Assistance from Australia) – Traffic is light but adjacent area has potential for development. – New bridge will be 2-lane with pedestrian walkway one side.	
5. Tanaemba River Bridge	– Approx. 33 km west of Honiara City, and traffic is light. – Bridge is on East-West Main Road and is important to residents in the area. – New bridge will be single lane with pedestrian walkway one side.	

(3) Bridge Length and Bridge Height

The bridge length and bridge finish height will be determined from the field studies and analysis of the hydrology. The hydrology has been analysed in paragraph 4.2.2, Hydrology of the Project Site, and flood studies have been made for 50 years. The bridge length and bridge height have been made to secure safety from the flood water area for 50 years. According to hearings made during the field studies, the High Water Level (HWL) during the 1986 cyclone did not reach the bridge beam level.

The bridge length and bridge height for the various bridges will be described in the following.

1) Alligator Creek Bridge

- The bridge length will be considered for a length similar to the existing bridge of 56.5m. The reasons for this are as follows:

  The waterway of the creek will not permit large amounts of water to flow, and the banks of the creek show signs of having been scoured by the changes in the sea level, and so a bridge length approximating the existing bridge is considered necessary.

  The remains of an old bridge support exist on the sea side, and the existing bridge was built as a replacement bridge. From the site conditions at the old bridge, the old bridge is assumed to have been a bridge of the length proposed.

- At the time of the field survey in December 1992, the water depth in the creek was approximately 2.00m, and the clear space between the bridge beam and the water was approximately 3.30m. Normally, there is no water flowing in the creek, and the volume of water is small, so it is assumed that rise in the water level when it rains is assumed to be small. For these reasons, the clear space below the beam can be maintained, and so the bridge height will be made the same as the existing bridge.

2) Metapono River Bridge

- From the conditions in the vicinity of the existing bridge and the width of the river, it is assumed that the present bridge length of approximately 68.80m is adequate. Hence, the proposed bridge will be of the same length.

- The space under the existing bridge is approximately 8.20m, and the HWL during the 1986 cyclone did not reach the bridge beam height. Hence the proposed bridge height will be similar to the existing bridge.

3) White River Bridge

- As the volume of water in the river is small, it will be possible to make the proposed new bridge shorter than the existing bridge of approximately 24.50m. There are protective gabions at the base of the abutments. If the new bridge abutments are constructed behind this, the bridge could be about 20.00m long.

- The proposed bridge will be raised 50 cm more than the existing bridge.

There is road improvement work being performed to the White River Bridge site at the present time, and it will not be wise to change the road level. The existing bridge is a Bailey Bridge (lower road bridge) and if the proposed bridge is to be the upper bridge, the space under the bridge will be reduced.

4) Mbonege River Bridge

- For the same reason for the Metapono River Bridge, the bridge length will approximately 70.00m long. The bridge height will be raised about 1m. The reasons are the same as for the White River Bridge.

5) Tanaemba River Bridge

- For the same reasons for the Metapono River Bridge, the bridge length will be approximately 27.00m long. The bridge height will be about the same as the existing bridge.

(4) Comparison of the Bridge Types

The following comparison will be made in accordance with the Basic Selection Conditions.

1) Earthquake Resistance

The Solomon Islands are in an earthquake zone. From past earthquake records, it is necessary to make the bridges resist the effects of earthquake motions.

2) Soil Foundation

The bearing strata at each bridge site is comparatively deep, and the foundation design will be made to reduce the number of foundation footings, and to design superstructures to be comparatively light weight.

3) The Conditions at the Rivers

There is heavy rainfall during the monsoon season from December to March in the Solomon Islands, and all the rivers where bridge work is planned are subject to flood waters. For this reason, the construction work in the river bed should be kept short and the selection of the bridge structure should conform with these conditions.

4) Maintenance and Operations

The budget for maintenance and operation of roads and bridges in the Solomon Islands is not adequate, and so the bridge structures should be designed for types that will require little maintenance and operations.

5) Construction Costs

The type of bridge construction should be selected for the lowest construction cost. In general, it can be said that shorter construction periods contribute to lower construction costs, and so the type of bridge selection should take this matter into top consideration.

4.4 Basic Design

4.4.1 Design of Superstructure

The type of superstructure will basically be of structural steel as described in paragraph 4.3.2. However in the case of comparatively long bridges, truss bridges or steel box-girder bridges will be compared in making the final decision.

The results of a study of the type and the length of bridge are given in Table 4.13.

The following types of superstructures will be considered for the five bridges:

1.	Alligator Creek Bridge	2-span continuous beam, steel bridge
2.	Metapono River Bridge	2-span, continuous beam, steel bridge
3.	White River Bridge	Simple composite H-beam bridge
4.	Mbonege River Bridge	2-span, continuous beam steel bridge
5.	Tanaemba River Bridge	Simple composite beam steel bridge

4.4.2 Design of Substructure

The type of substructure will be decided depending on the loads from the superstructure and the balance with it. The conditions to be taken into consideration are the direction of the loads from the superstructure and their magnitude, the harmony with the type of superstructure, the direction of the waterway flow, seismic structure, and location of the footing (depth of footing). The types of pier are wall type, bent, or the round column type, and each type has the structural characteristics, constructability, obstruction of the water flow, and appearance, and these have been given in Table 4.14.

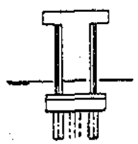
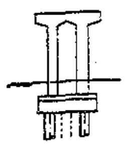
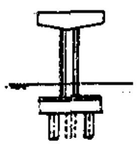
The substructure can be of the wall type or in the case of narrow bridges of the round column type.

Table 4.13 Comparison of Superstructure Types

Bridge Name		Comparative Plans			Evaluation			Type Selected
		Type	Spans (m)	Cost	Constructability	Const. Period	Material	
Alligator Bridge	Plan 1	2 span simple steel girder	2 @ 28	◎	○	○	○	
	Plan 2	2 span continuous steel girder	2 @ 28	○	◎	◎	◎	○
	Plan 3	simple steel box girder	56	△	△	△	○	
	Plan 4	simple truss	56	×	◎	◎	○	
Metapono Bridge	Plan 1	2 span simple steel girder	2 @ 35=70	◎	○	○	○	
	Plan 2	2 span continuous steel girders	2 @ 35=70	○	○	◎	◎	○
	Plan 3	simple truss	70	×	◎	◎	○	
Mbonege Bridge	Plan 1	2 span simple steel girder	2 @ 35=70	◎	○	○	○	
	Plan 2	2 span continuous steel girders	2 @ 35=70	○	○	◎	◎	○
	Plan 3	simple truss	70	×	◎	◎	○	

◎ : Best ○ : Good △ : Acceptable × : Poor

Table 4.14 Comparison of Bridge Piers

Type	Structural Characteristics	Constructability	River Flow Obstruction	Appearance	Cost	Overall Result
Solid Wall Type 	• Most common type with oval shaped column when constructed in river • Resistant to earthquake forces ○	• Requires special forms when placing concrete ×	• No special problem, but obstructs flow when constructed in bends of rivers ○	○	1.00	○
Rigid Frame Type 	• Suitable for high pier support to reduce weight • For low heights pier the stress caused by temperature change is large. ×	• Requires supports for concrete forms • Requires large amount of reinforcing steel and good quality of concrete △	• Can obstruct river flows by flowing timbers ×	×	1.05	△
T-Shaped Type 	• The width of the head will conform to width of bridge deck. The column can be made small. • Reducing of pier dimension will allow use of space below the bridge deck. • Used when bridge width must be kept small. △	• Requires supports for concrete forms △	• Suitable for use at bands in the river. Causes more obstruction to the river flow compared to the solid wall type. ○	○	1.10	○

○ : Better   △ : Acceptable   × : Poor

4.4.3 Design of Foundation

The design of the type of foundation will depend on the soil conditions, the constructability, and the capacity of the equipment being used. For this project, the prefabricated piles (reinforced concrete piles, steel pipe piles), cast-in-place concrete piling, etc. can be considered.

A comparison of the different foundations are given in Table 4.16.

- Reinforced concrete piles can be fabricated with materials procured locally, but if the piles with excessive lengths are required, there will be vibration and noise nuisance generated for the neighbours in the bridge site vicinity. The construction period will also be long.

- Cast-in-place concrete piling will create little noise and vibration to the adjacent structures and is used in the construction within city areas, but the disposal of the sludge, and the skill in the construction could affect the degree of the finished work, and could cost more than steel pipe piling.

- Steel pipe piles can be used as bearing piling or friction piles, have a large sectional rigidity, can resist large bending moments, and are able to bear up to horizontal forces. They are much lighter than concrete piles, and are fairly easy to handle and are not susceptible to breaking. Steel pipe piles can be driven by vibro-hammers, and give off less noise and vibration than concrete piles which have to be driven with diesel hammers. The construction period will be comparatively shorter.

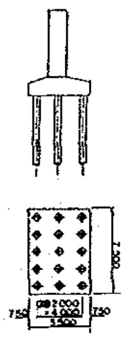
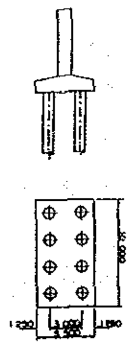
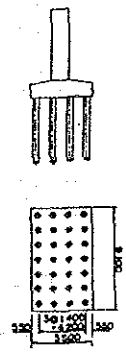
Based on the above points, steel pipe piles will be used for the bridge foundations.

Cost comparison was made for the steel pipe piles, and the optimum steel pipe pile was selected. As shown in Table 4.15, the steel pipe pile of 600 ømm, t=9mm thickness has the desirable characteristics and this size was selected.

Table 4.15 Comparison of Steel Pipe Piles

Dimension	Pile Layout	Material: Steel Pipe	Material: Concrete	Cost Benefit
600 ømm	n = 15	o	o	o
700 ømm	n = 13	o	o	Δ
800 ømm	n = 12	o	o	x

Table 4.16 Comparison of Pile Types

	Steel Pipe Piles	Cast-in-place Concrete Pile	Reinforced Concrete Pile
Type of Foundation			
Structural	The pile will be 600 ømm of medium size, and will be the best balanced type. ○	The smallest size of pile diameter will be 1,000 ømm, and the footing size will be determined by the smallest number of piles required. △	As the cross section of each pile is small, the foundation will be able to cope with changes in the load. △
Construct-ability	Weight of pile is small compared with concrete piles, is easy to hoist and will not break easily. ○	Muddy waters and clay are a problem. △	There will be a large number of piles to drive and requires a long time. Noise and vibration caused by driving operations will cause environmental problems. △
Cost	1.00 ○	1.10 △	1.15 ✕
Overall Evaluation	○	△	✕

○ : Good △ : Acceptable ✕ : Poor

4.4.4 Design of Approach Roads

(1) Geometric Design Conditions

The proposed approach roads (including bridges) can be classified according to the road classification standard as described in Table 4.17.

Class II	Metapono River Bridge Approach Road Tanaemba River Bridge Approach Road
Class III	Alligator Creek Bridge Approach Road White River Bridge Approach Road (Left bank of the river)
Class V	White River Bridge (Right bank of the river)

However, the geometric conditions of the existing approach roads are not always satisfactory to satisfy the above-mentioned standards as explained in the existing approach road conditions.

The geometric design conditions for this project are determined as shown in Table 4.17 referring to the standard in Table 2.2, the existing road conditions, minimization of new roads and the consideration for the connection to the one-lane bridges. The geometric design standard of Japan is also applied.

The typical cross sections of the approach roads are shown in Fig. 4.4.

Table 4.17 Geometric Design Standard of Approach Roads

Items	Unit	Class II	Class III	Class V
Design Speed	km/hr	40	60	60
Min. Radius	m	50	120	120
Superelevation	%	10	7	7
Run-off Ratio of Lane	–	1/25	–	–
Max. Gradient	%	7	5	5
Vertical Curve				
Min. Radius of Crest	m	450	1,400	1,400
Min. Radius of Sag	m	450	1,000	1,000
Min. Length of Curve	m	35	50	50
Crossfall of Carriageway	%	2	2	2
Carriageway Width	m	6.0	7.0	7.0*
Shoulder Width	m	1.25	1.25	1.75*

(2) Pavement Design Conditions

DBST can be applied to the pavement design according to the BS standard, Road Note 29 for a 20-year life.

The pavement structure is shown in Fig. 4.4.

(3) Plan and Profile

Horizontal alignment is designed based on the conditions as shown below:

- Alignments in the bridge sections shall be straight line in order to avoid construction difficulties.

- The space between the proposed bridge and the existing bridge shall be kept approximately 5m in order to obtain working space for the new construction of the bridge and to avoid any danger to the existing bridge.

- The straight line shall be applied just behind the bridge because the superelevation does not appear in the bridge section for ease of construction.

- The length of the approach road will be minimized.

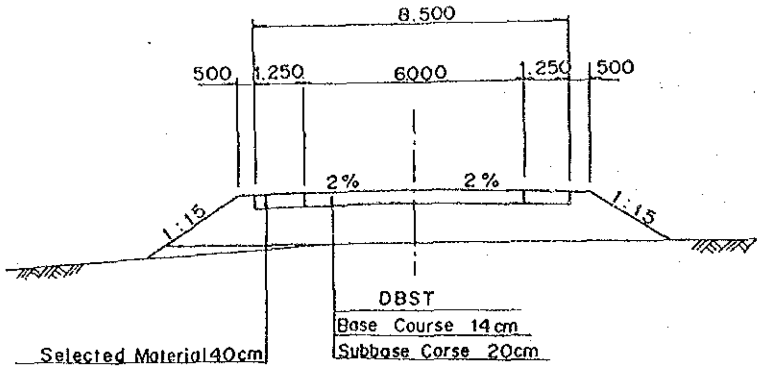
Vertical alignment is designed based on the conditions as below:

- The clearance between the bottom girder and water surface can be properly kept as shown in paragraph 4.2.2.

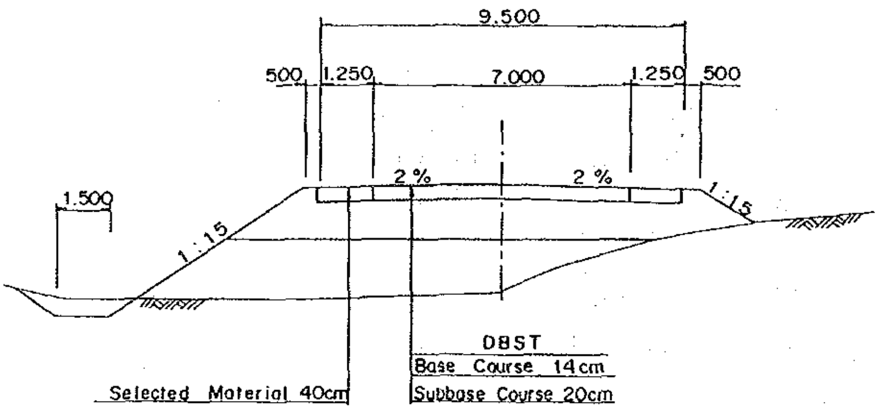
- Min. 0.3% can be applied in the bridge section in order to obtain smooth drainage.

- Vertical curve is not applied in the bridge section.

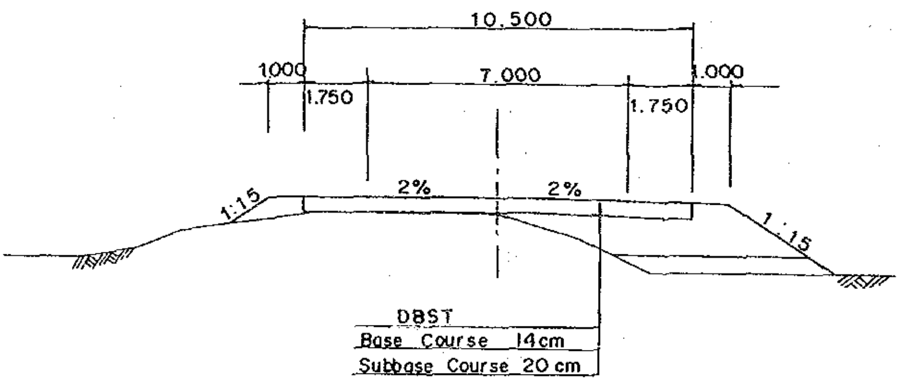
- Vertical alignment is determined to minimize the embankment materials.



Class II



Class III



Class V

Fig. 4.4 Typical Cross Sections

The outline of each approach road is shown below (the details refer to the drawing).

1) Alligator Creek Bridge Approach Road

The new bridge will be constructed on the downstream side of the existing bridge.

Horizontal alignment consists of the straight line behind the bridge section including bridge and S-shaped curve connecting to the existing road.

The gradient of vertical alignment is not a steep slope, which has the crest at a point 25m left from the bridge. In the bridge section, the gradient is 0.3% and at the connection to the existing road the crest curve and sag curve are inserted.

This pattern of the alignment is almost applied to other bridge approaches.

2) Metapono River Bridge Approach Road

The new bridge will be constructed at the upstream side from the existing bridge.

Horizontal alignment consists of the straight line behind the bridge section including bridges and curves combined with the existing curve with new alignment.

The gradient of vertical alignment has the crest at a point 23m right from the right side of the bridge.

3) White River Bridge Approach Road

The new bridge will be constructed at the location of the existing bridge after its removal by demolition.

Horizontal alignment consists of the straight line behind the bridge section including the bridge, and the curves, namely single curve at left side of the bridge and S-shaped curve at the right side of the bridge.

The gradient of vertical alignment is not a steep slope which has the crest at a point 25m left side from the bridge.

4) Mbonege River Bridge Approach Road

The new bridge will be constructed at the downstream side of the existing bridge.

Horizontal alignment consists of the straight line behind the bridge section including the bridge, and the curves namely, single curve at the left side of the bridge and S-shaped curve at the right side of the bridge.

The gradient of vertical alignment is not steep which has the crest at a point 30m left from the left side of the bridge.

The proposed height of the new bridge is approximately 1m higher than the existing bridge.

5) Tanaemba River Bridge Approach Road

The new bridge will be constructed at the downstream side from the existing bridge.

Horizontal alignment consists of the straight line behind the bridge section including the bridge and the curves, namely S-shaped curve combined the existing curve with new alignment at the left side of the bridge and single-curve near the existing culvert.

The gradient of vertical alignment is steep which has the crest at a point 23m right from the bridge.

4.5 Basic Design Drawings

The Basic Design Drawings will be prepared so that design quantities could be taken off. General drawings will contain sufficient details, together with

Fig. 4.5 GENERAL VIEW
(ALLIGATOR CREEK BRIDGE)

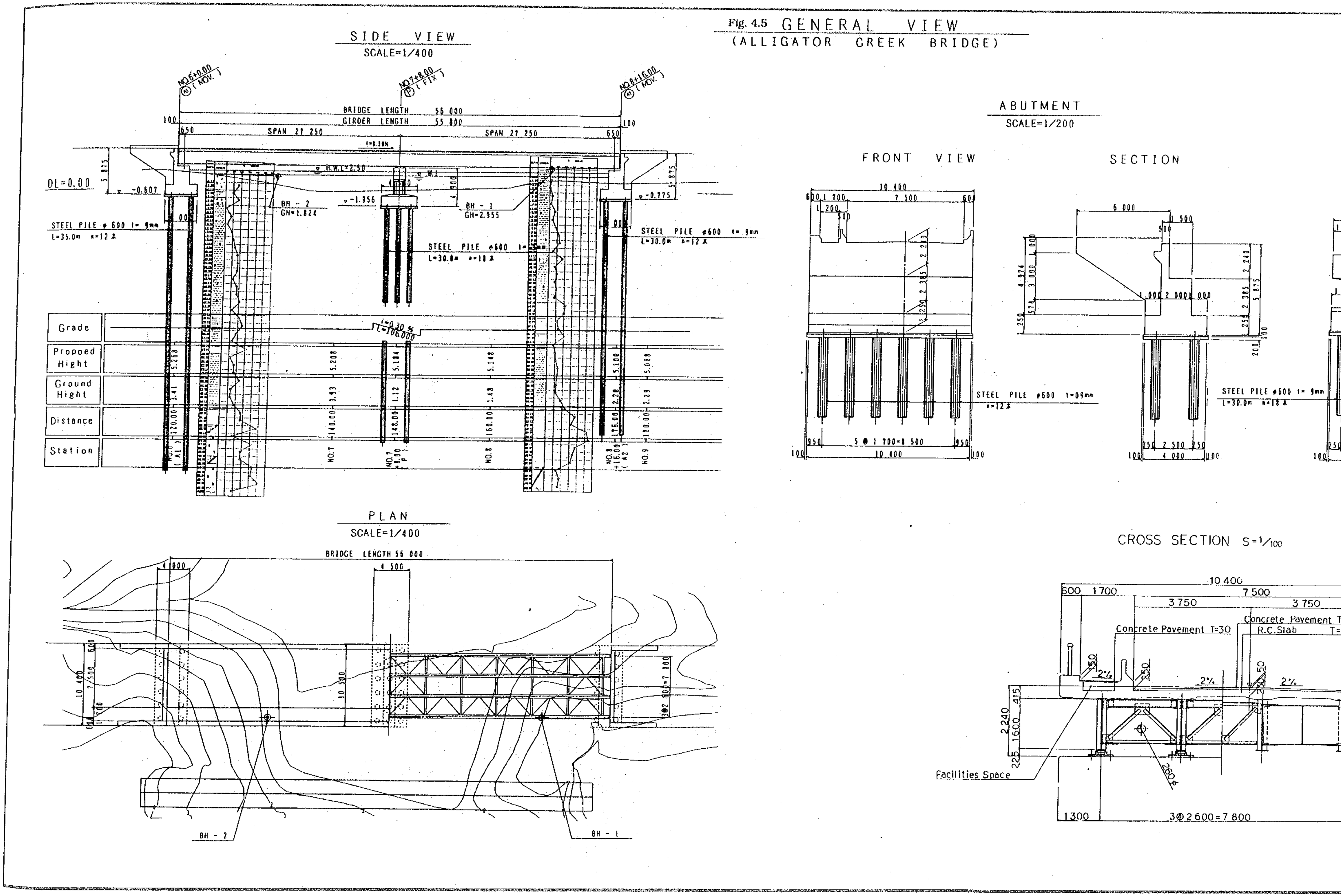


Fig. 4.5 GENERAL VIEW
(ALLIGATOR CREEK BRIDGE)

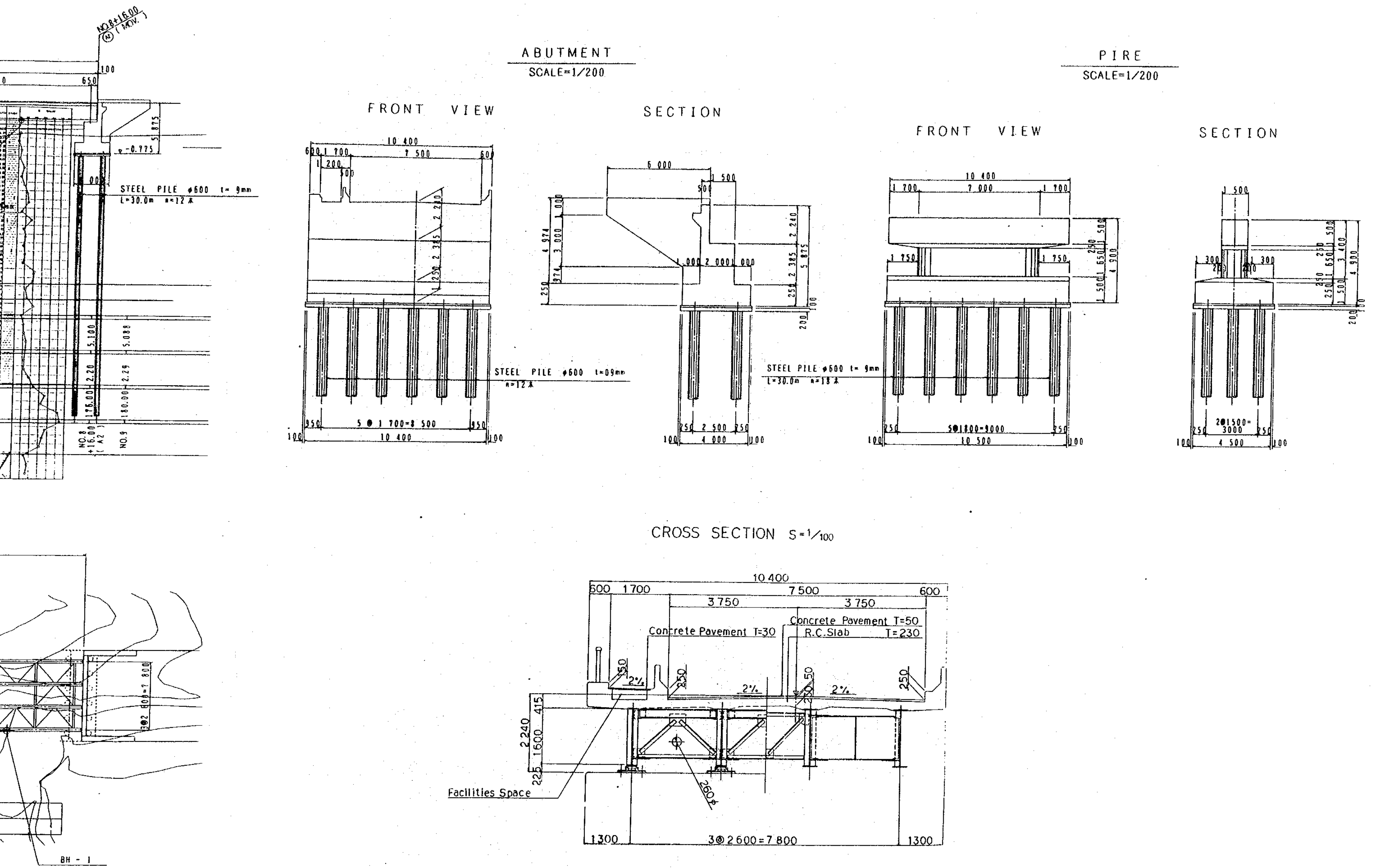


Fig. 4.6 GENERAL VIEW

(METAPONO BRIDGE)

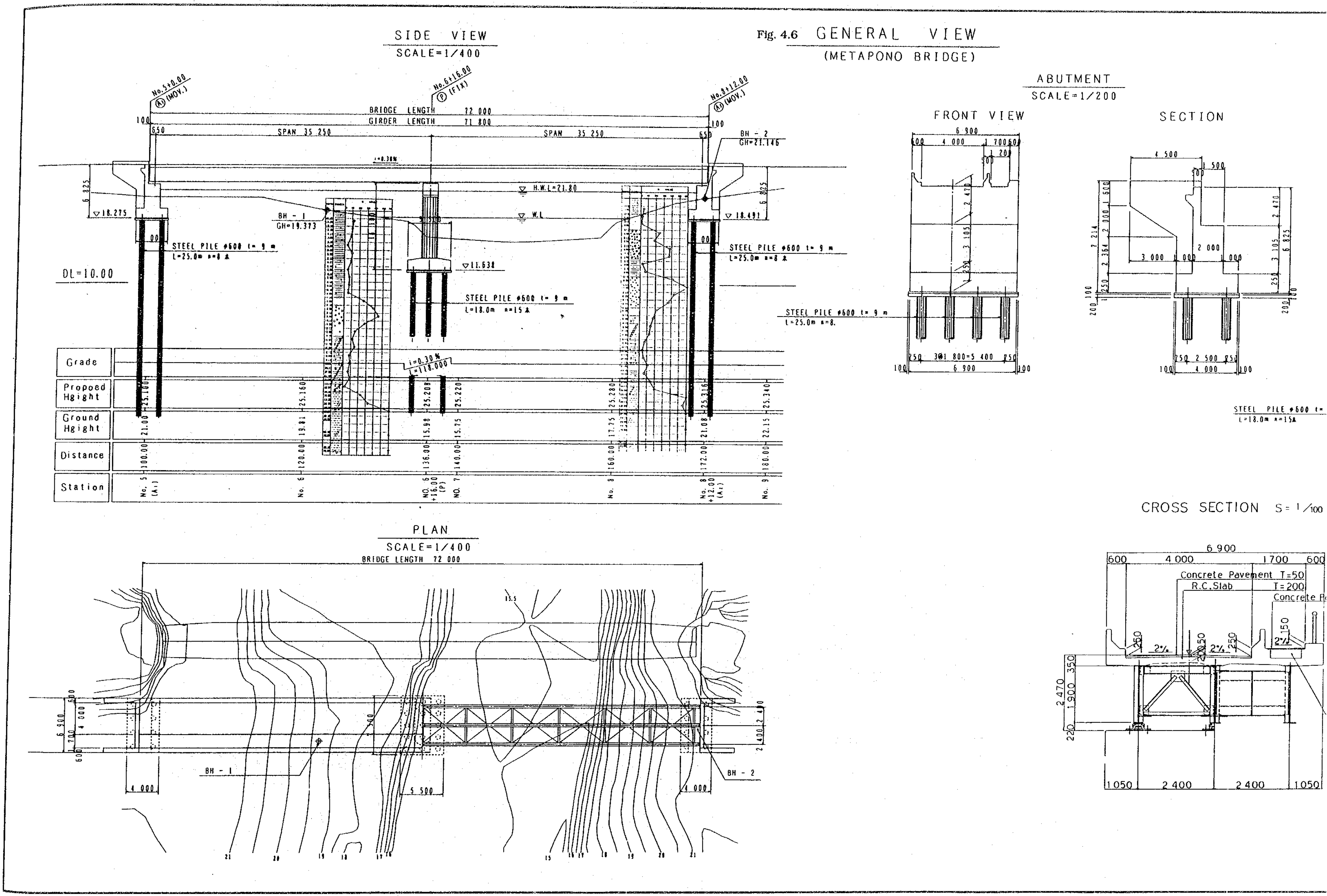


Fig. 4.6 GENERAL VIEW

(METAPONO BRIDGE)

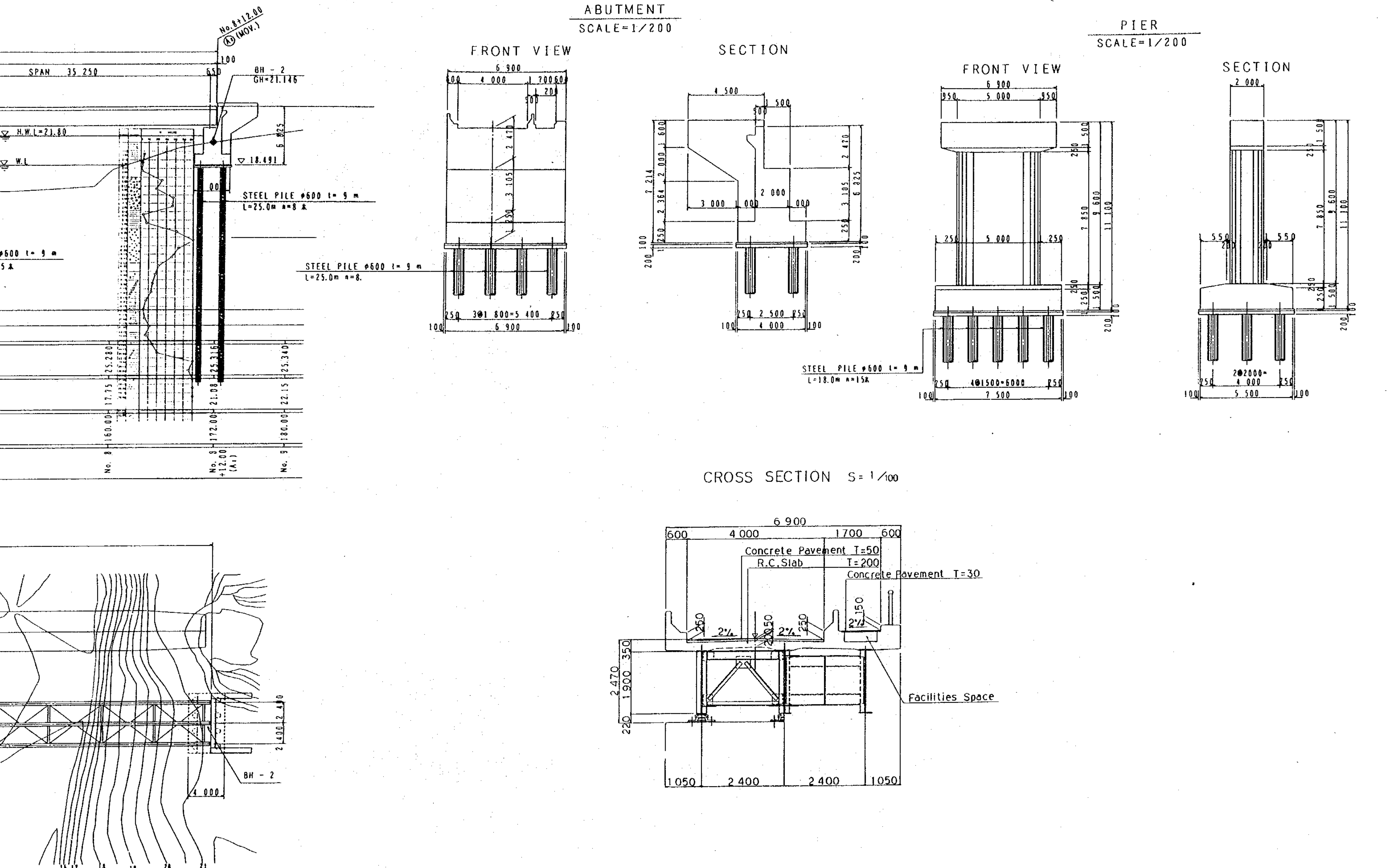


Fig. 4.7 GENERAL VIEW
(WHITE RIVER BRIDGE)

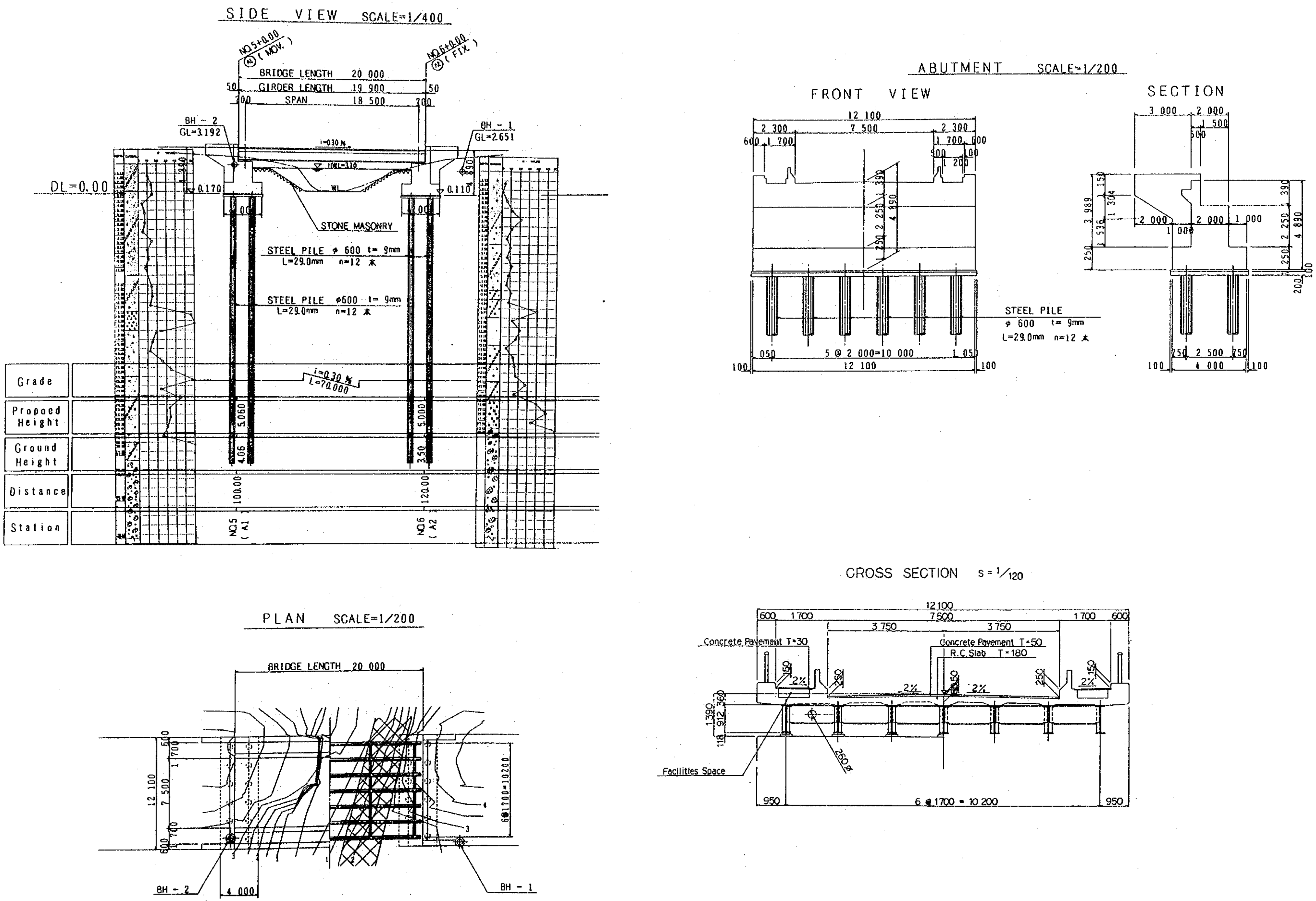


Fig. 4.8 GENERAL VIEW (MBONEGE RIVER BRIDGE)

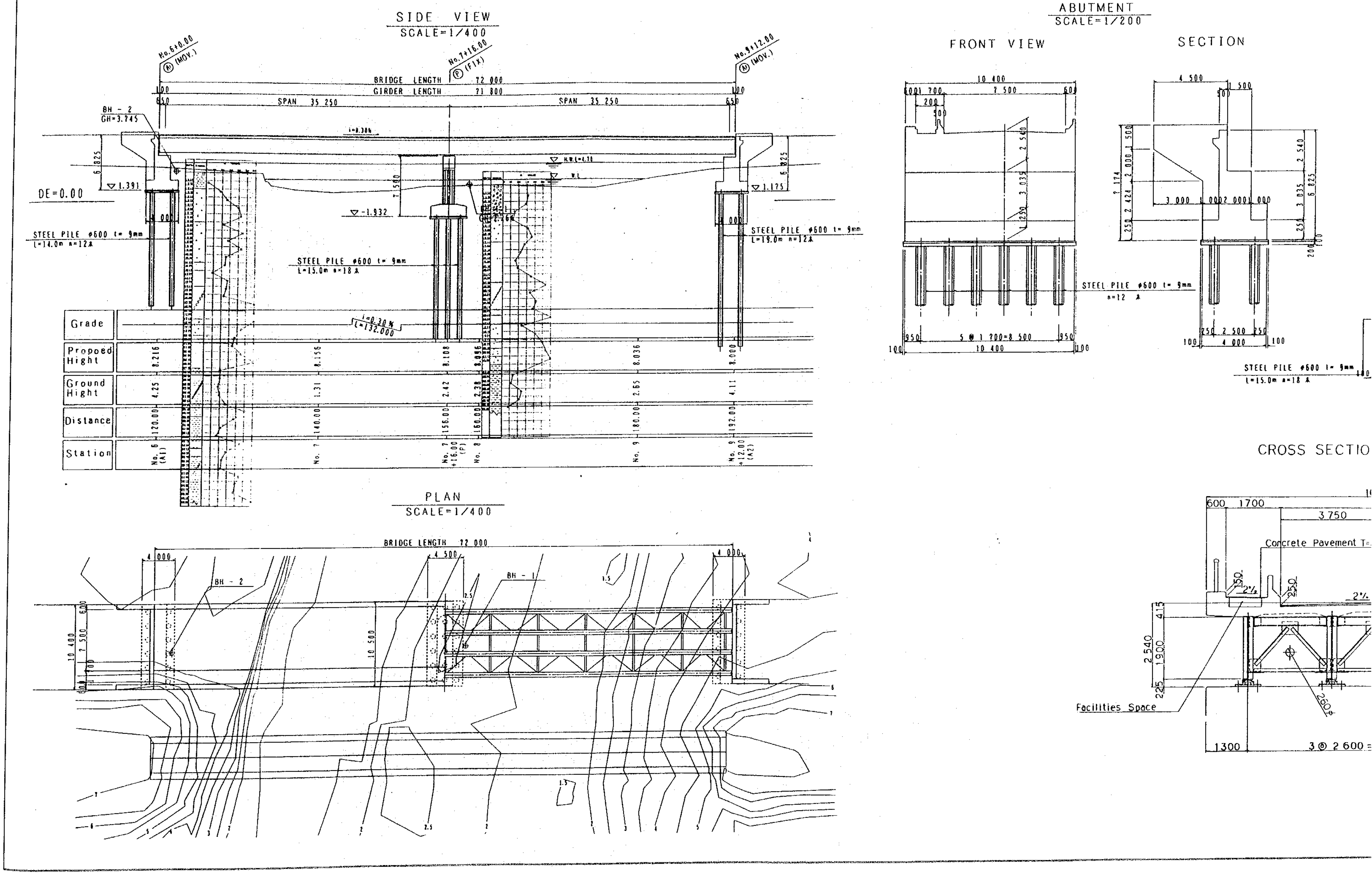


Fig. 4.8 GENERAL VIEW
(MBONEGE RIVER BRIDGE)

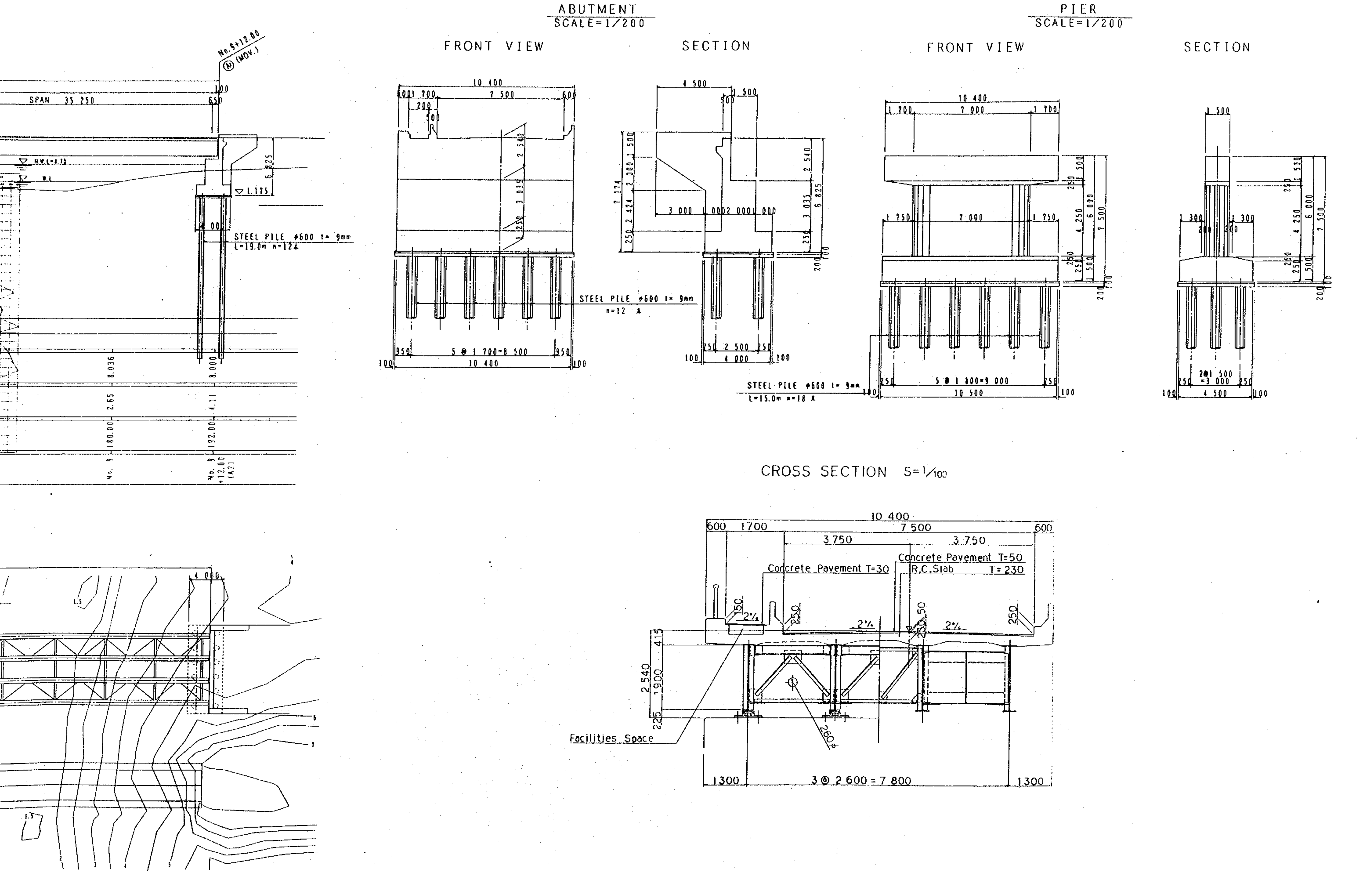


Fig. 4.9 GENERAL VIEW
(TANAEMBA RIVER BRIDGE)

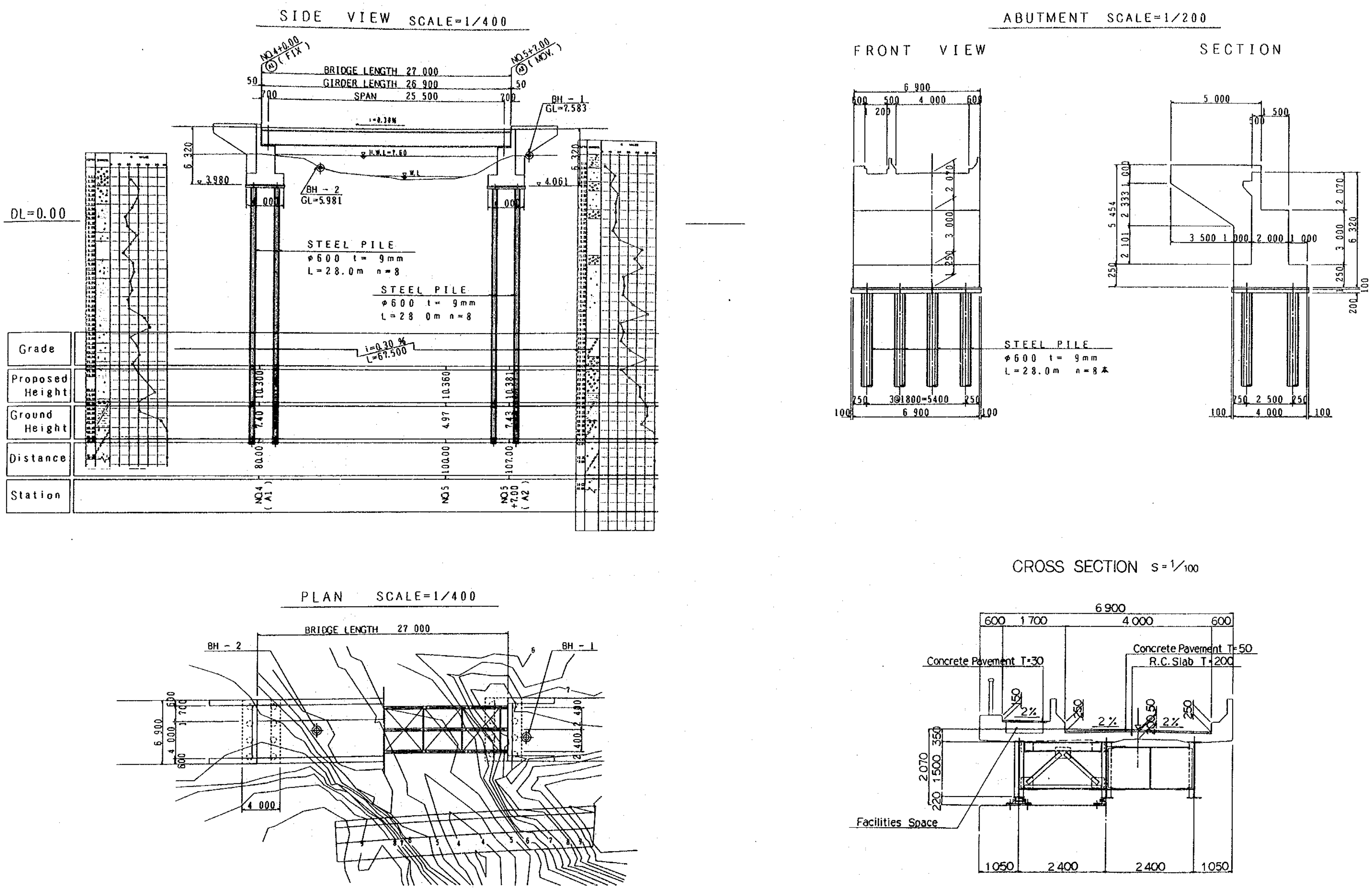
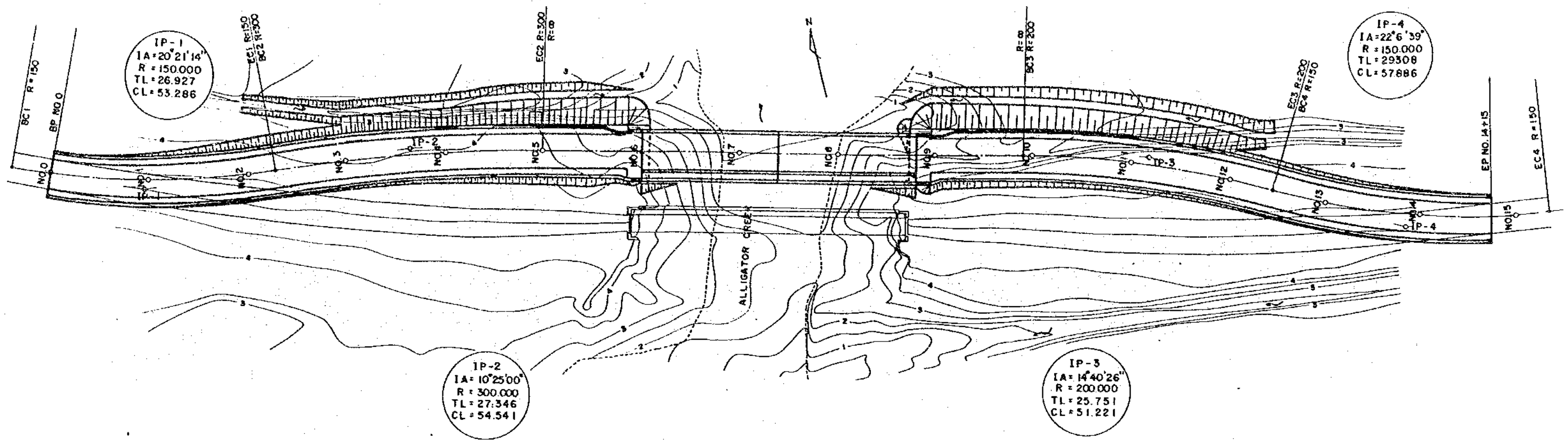
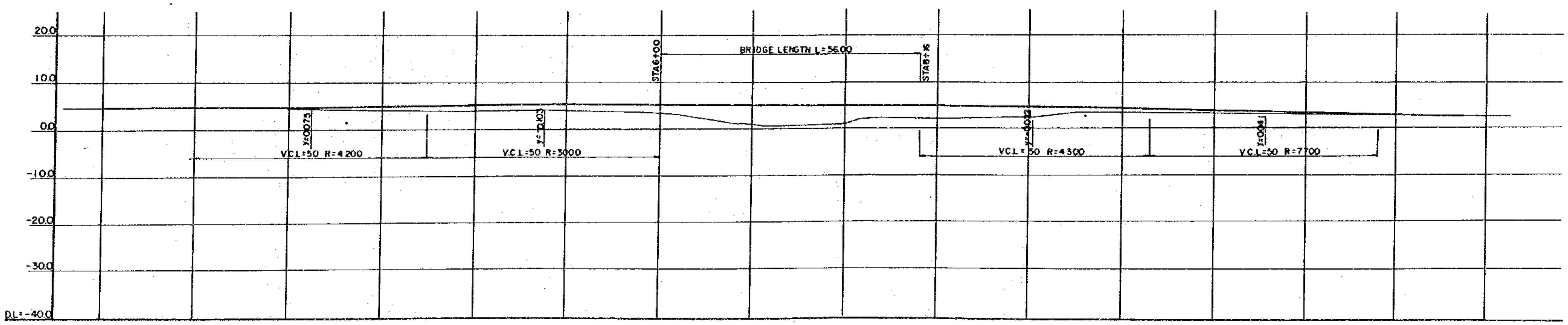


Fig. 4.10 Approach Road (Alligator Creek Bridge)

PLAN S=1/1000



PROFILE S=1/1000



NO	ACC. DISTANCE	GROUND HEIGHT	PROPOSED HEIGHT	GRADE
NO.0	0.0	4.62	4.620	4.620
NO.1	20.0	4.58	4.650	
NO.2	40.0	4.44	4.728	
+5.0	45.0		4.743	4.668
NO.3	60.0	3.88	4.883	
NO.4	80.0	4.00	5.124	
+15.0	95.0		5.240	5.343
NO.5	100.0	4.37	5.262	
NO.6	120.0	3.42	5.268	
NO.7	140.0	-0.86	5.208	
NO.8	160.0	1.06	5.148	
+16.0	176.0		5.100	
NO.9	180.0	2.16	5.087	
NO.10	200.0	2.61	5.008	
+1.0	201.0			5.025
NO.11	220.0	4.03	4.901	
NO.12	240.0	4.33	4.785	
+11.0	251.0		4.741	4.700
NO.13	260.0	4.45	4.717	
NO.14	280.0	4.67	4.700	
+15	295.0		4.700	
NO.15	300.0	4.70	4.700	4.700

Grade: i=0.15%; i=0.15% ℓ=45.000; i=1.35% ℓ=50.000; i=0.30% ℓ=106.000; i=0.65% ℓ=50.000; LEVEL ℓ=49.000

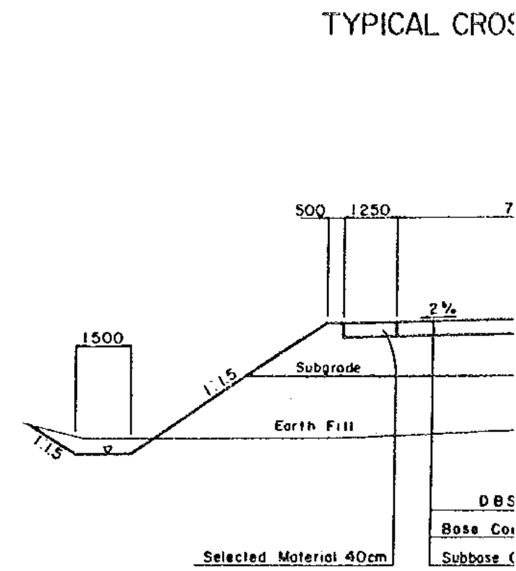
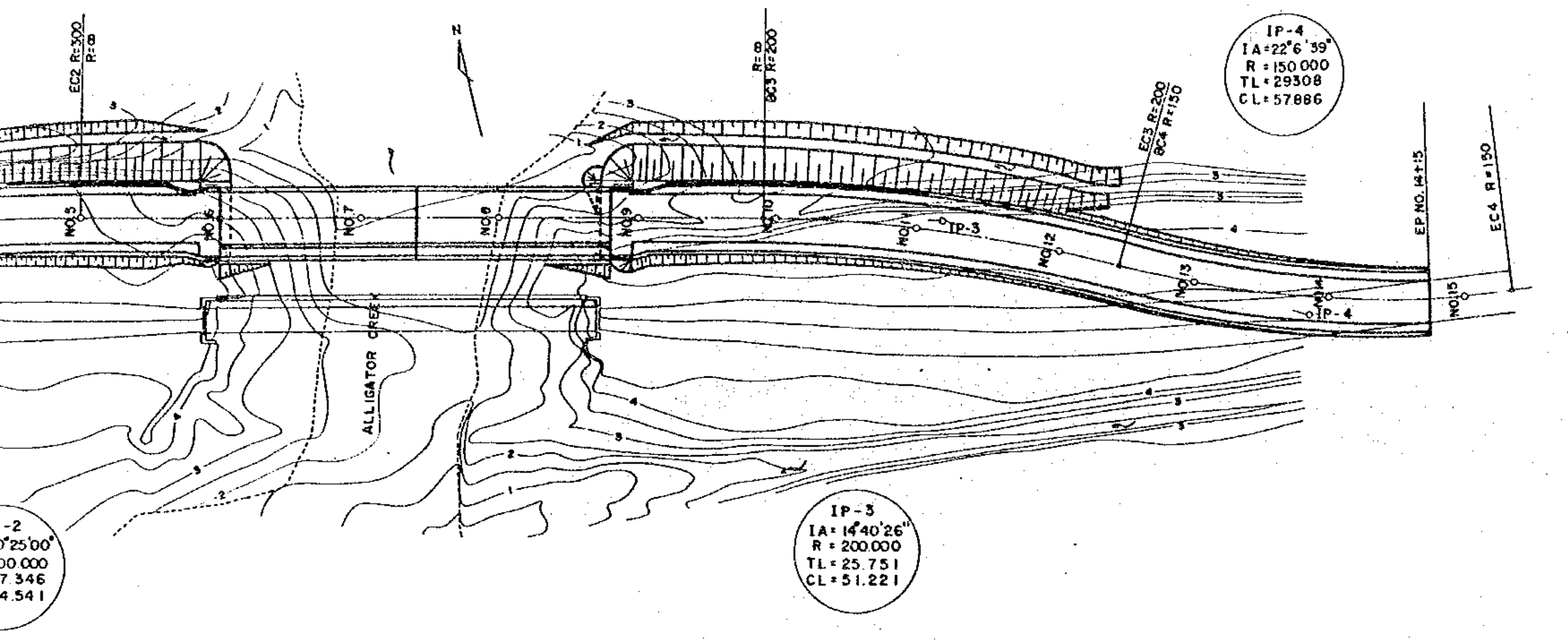
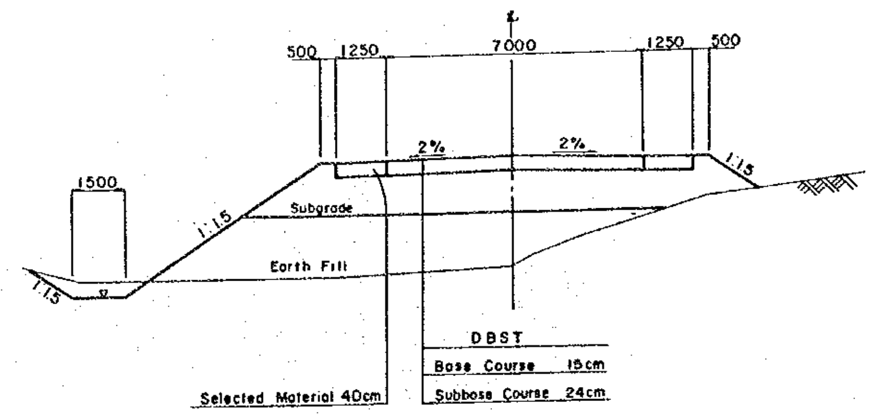


Fig. 4.10 Approach Road (Alligator Creek Bridge)

PLAN s=1/1000



TYPICAL CROSS SECTION s=1/200



PROFILE s=1/1000

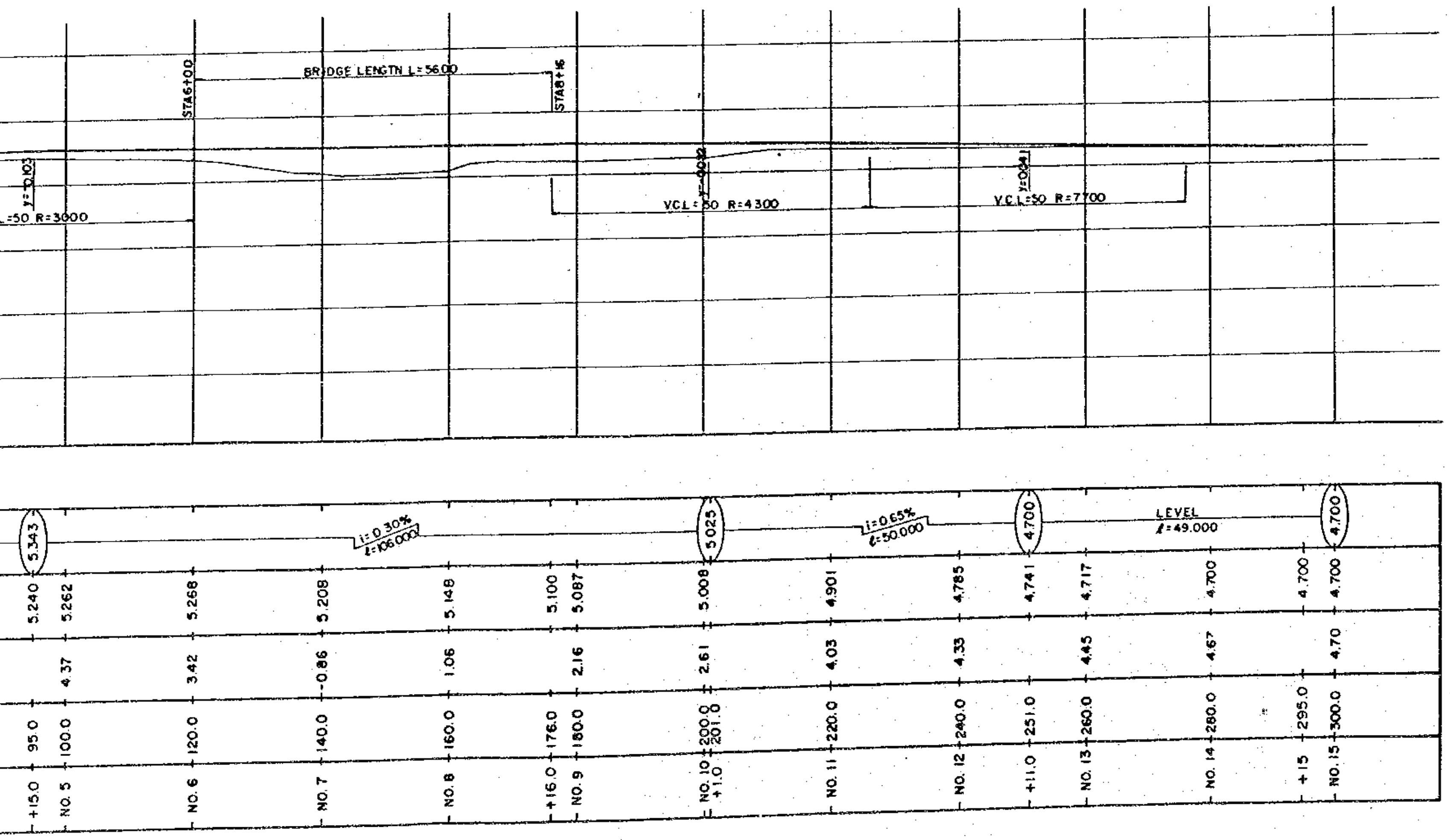


Fig. 4.11 Approach Road (Metapono River Bridge)

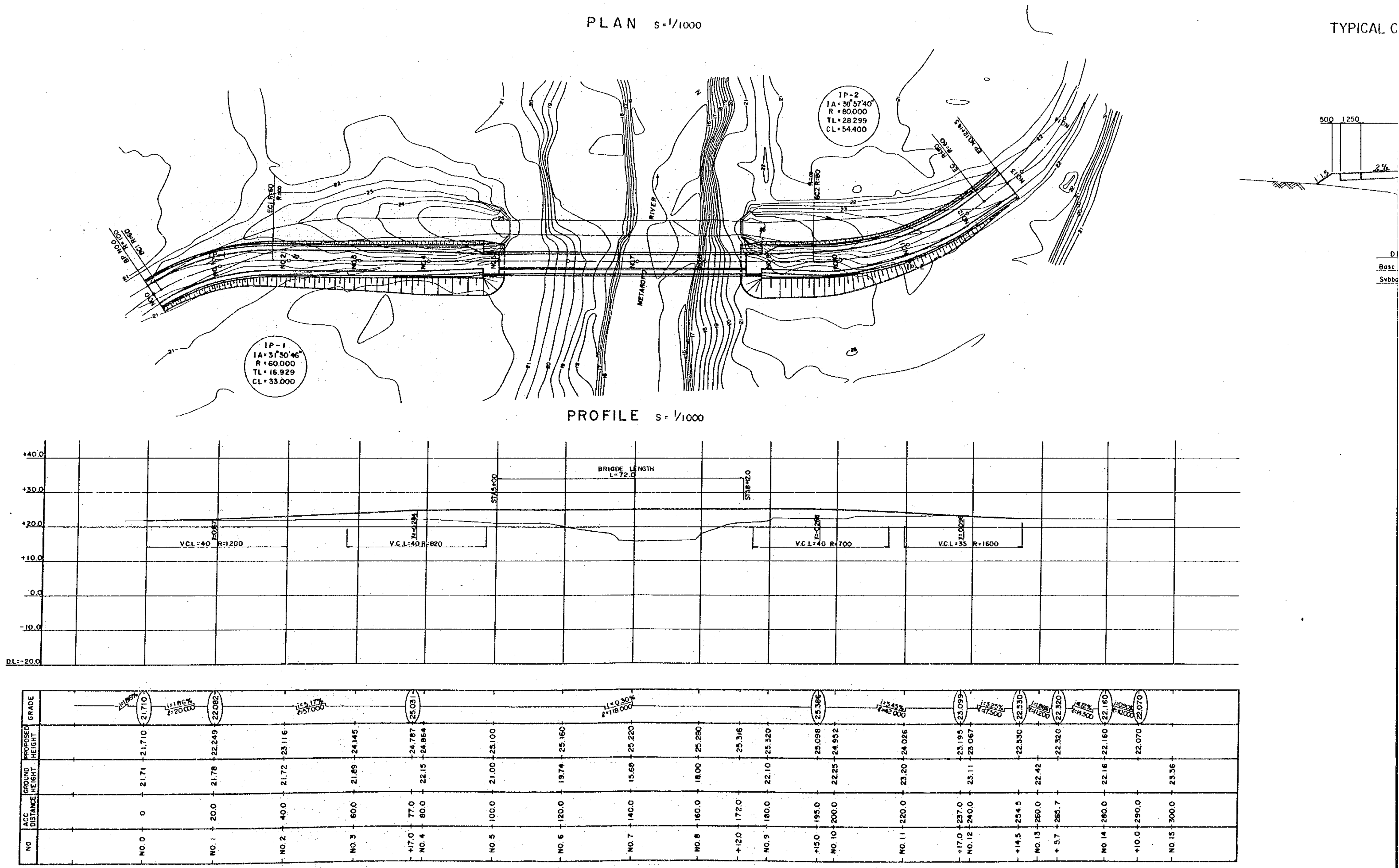
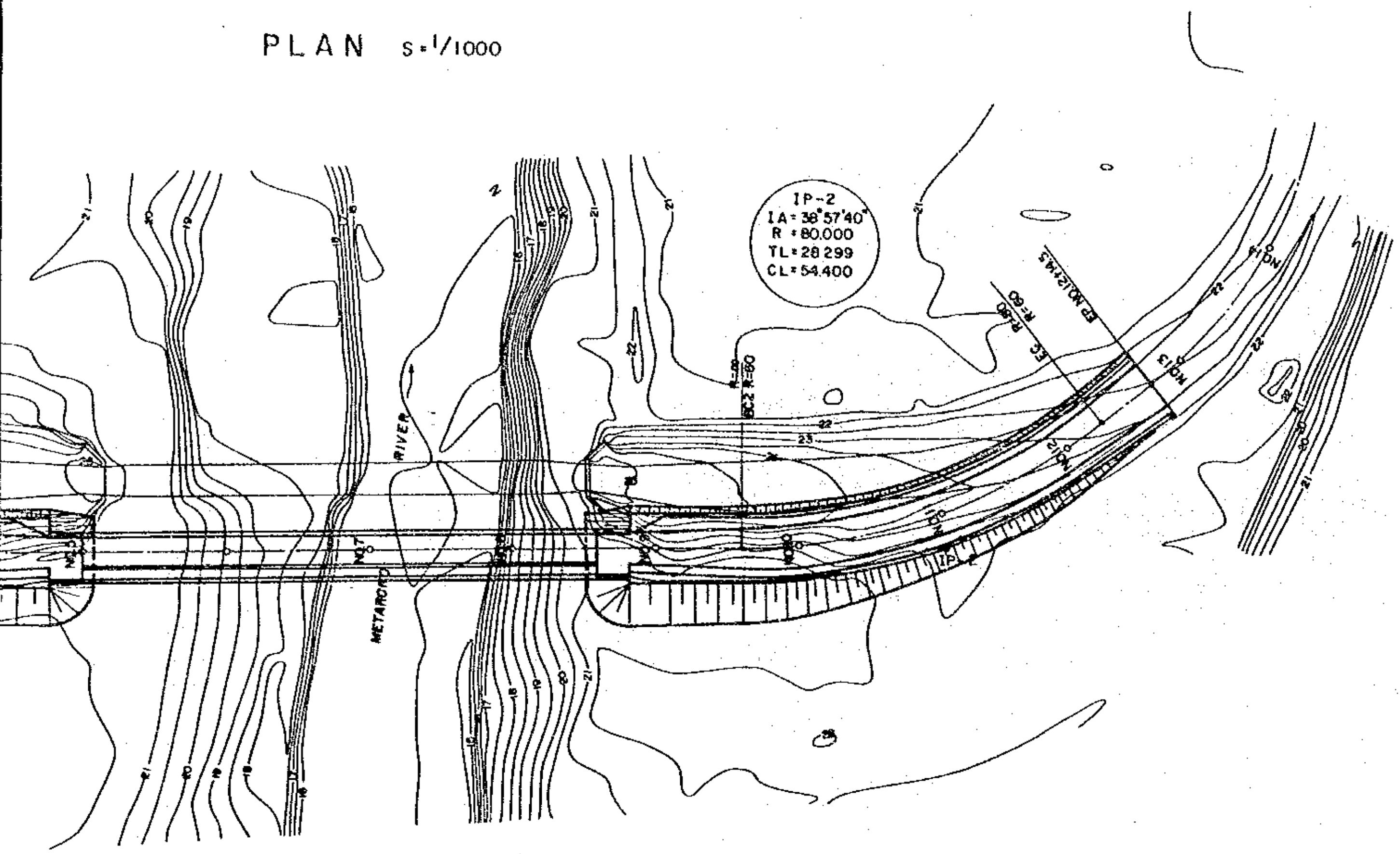
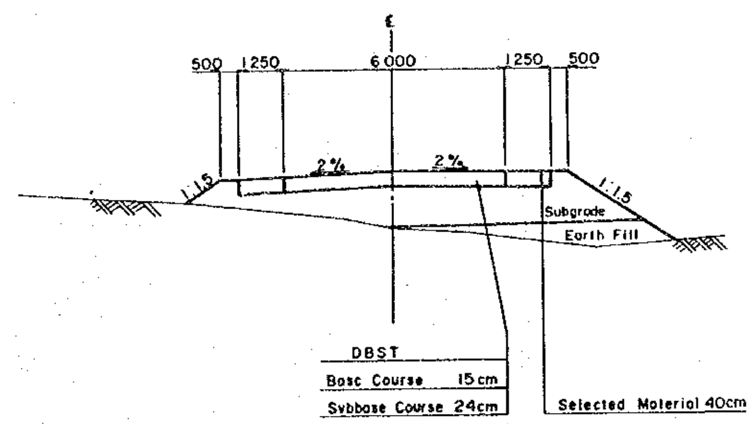


Fig. 4.11 Approach Road (Metapono River Bridge)

PLAN S=1/1000



TYPICAL CROSS SECTION S=1/200



PROFILE S=1/1000

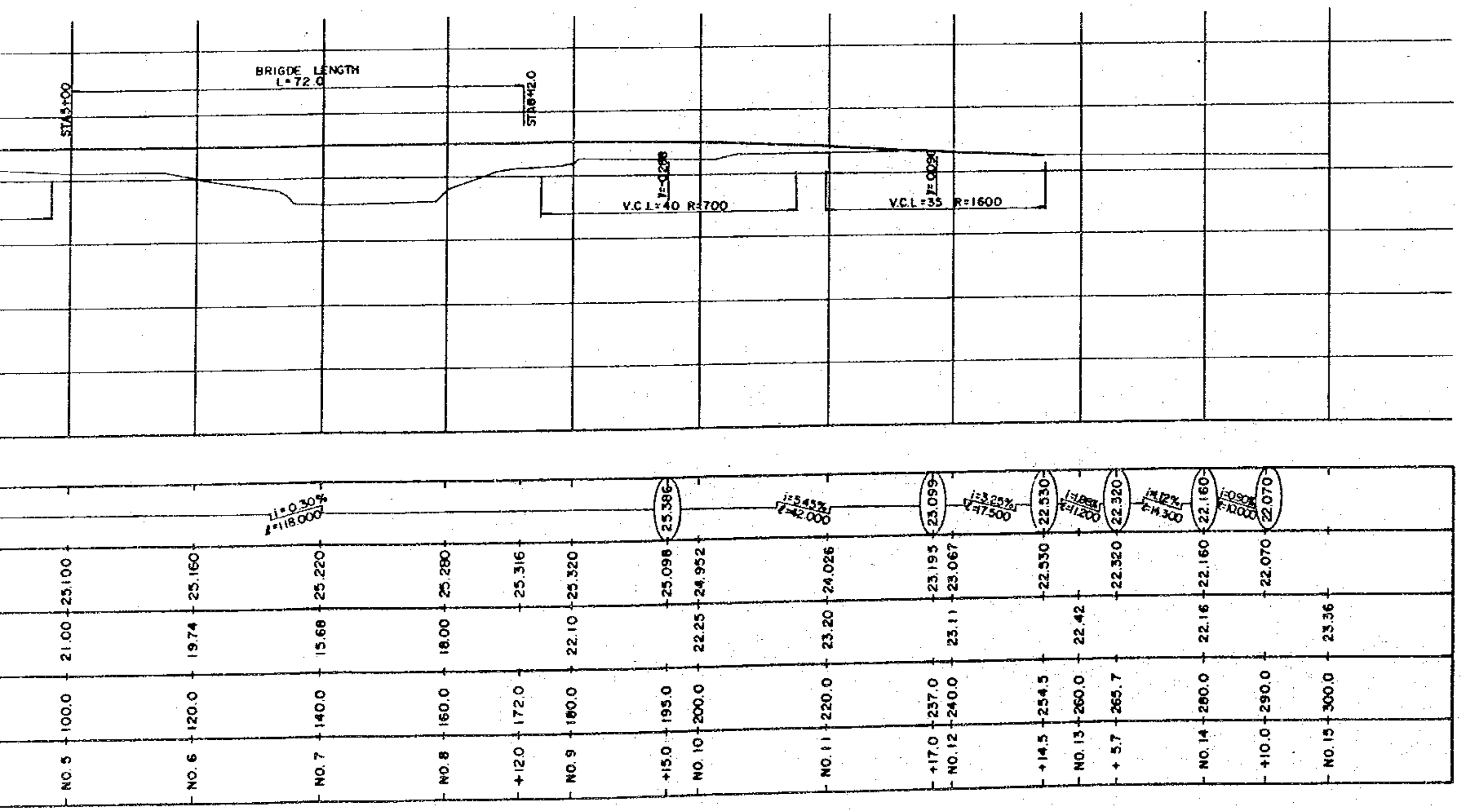
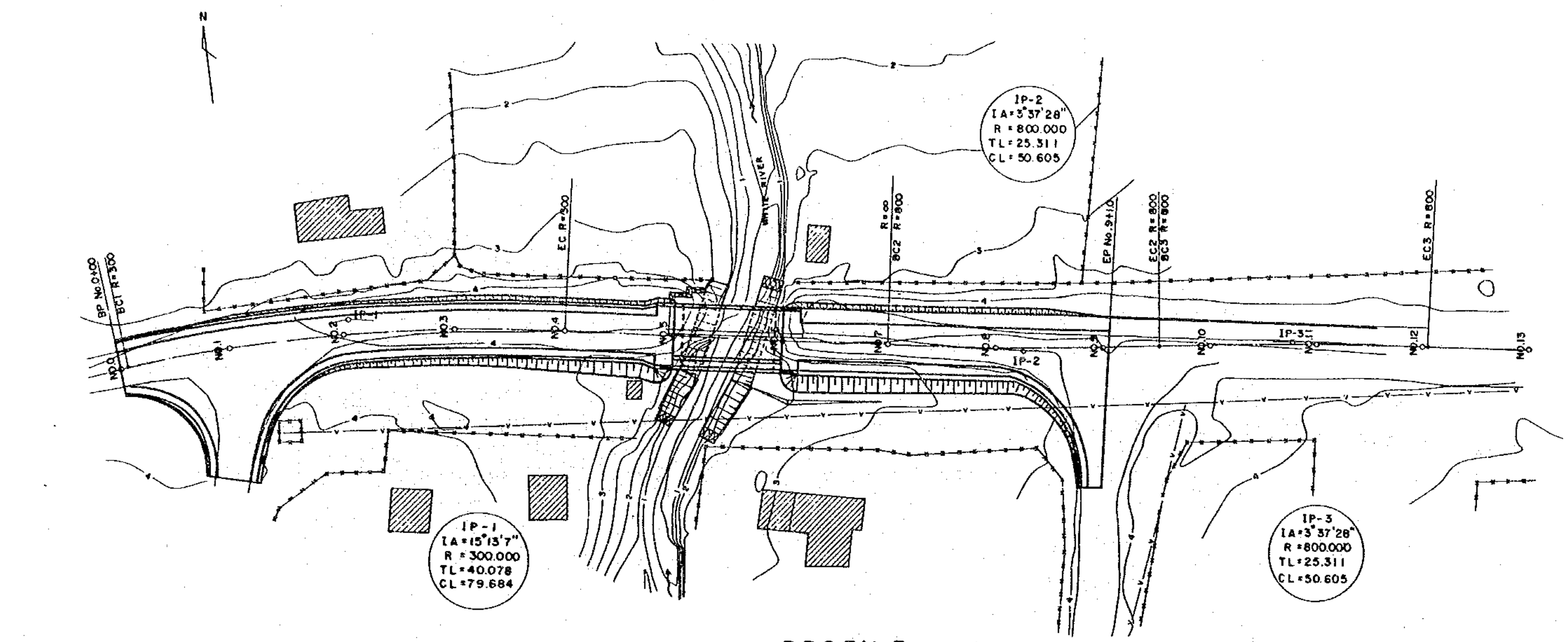
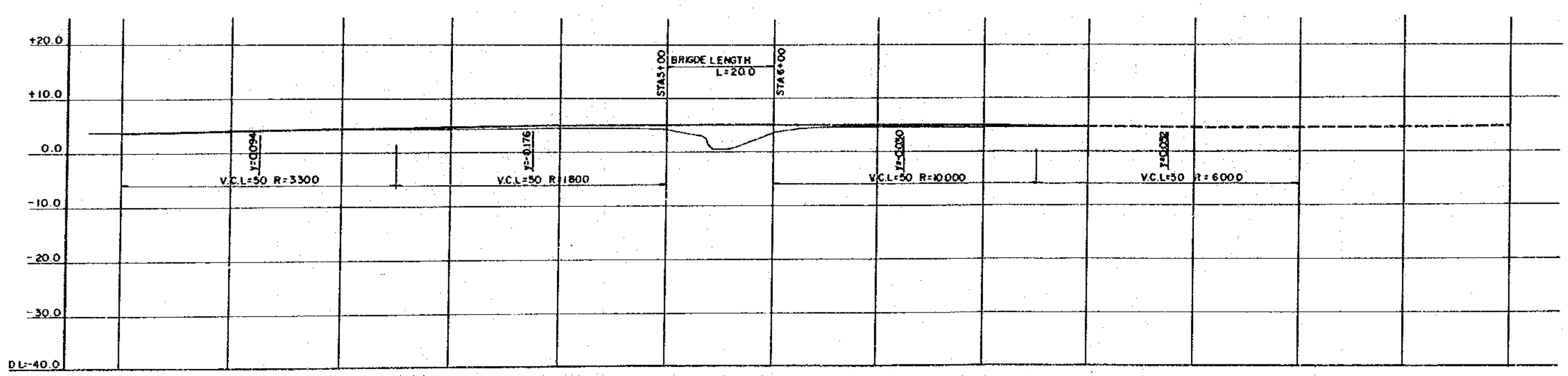


Fig. 4.12 Approach Road (White River Bridge)

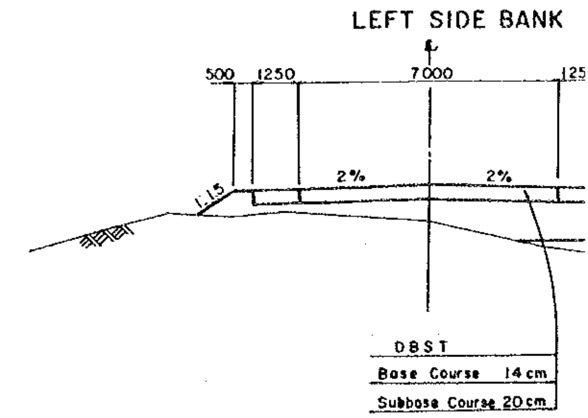
PLAN S=1/1000

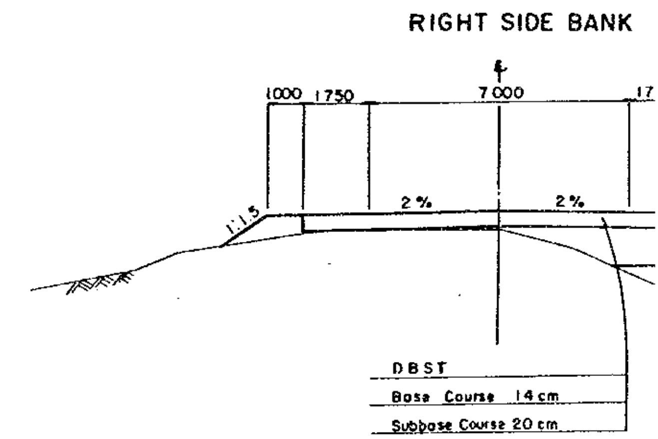


PROFILE S=1/1000



TYPICAL CROSS SECT



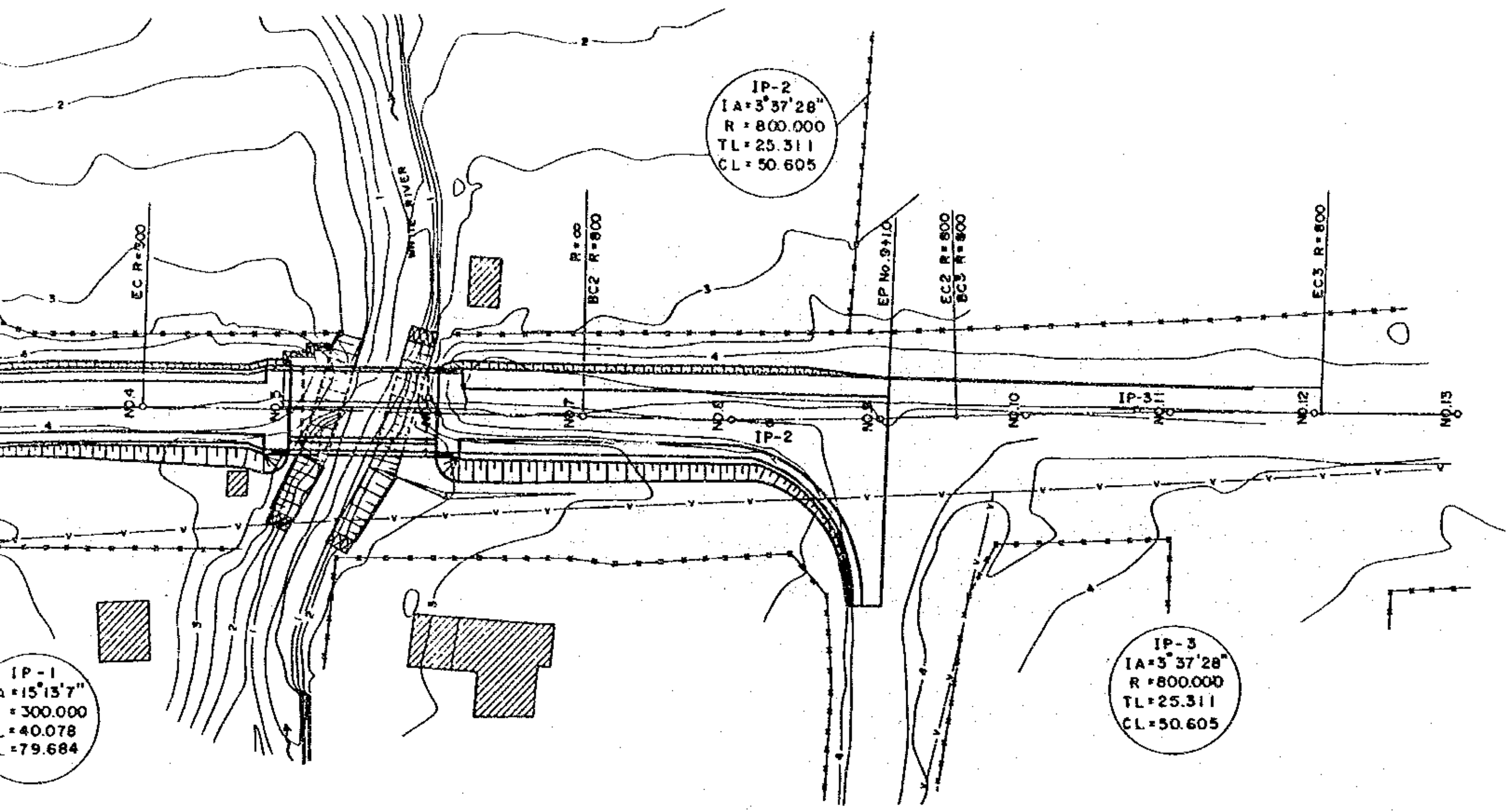


NO	ACC. DISTANCE	GROUND HEIGHT	PROPOSED HEIGHT	GRADE
NO.0	0.0	3.63	3.630	3.630
NO.1	20.0	3.79	3.890	
+5.0	25.0		3.974	3.880
NO.2	40.0	4.03	4.272	
NO.3	60.0	4.32	4.731	
+15.0	75.0		4.959	5.135
NO.4	80.0	4.44	5.008	
NO.5	100.0	4.21	5.060	
NO.6	120.0	3.50	5.000	
NO.7	140.0	4.49	4.921	
+5.0	145.0		4.895	4.925
NO.8	160.0	4.42	4.803	
NO.9	180.0	4.51	4.660	
+15.0	195.0		4.587	4.535
NO.10	200.0	4.50	4.571	
NO.11	220.0	4.50	4.560	4.560
NO.12	240.0	4.56		
NO.13	260.0	4.58		

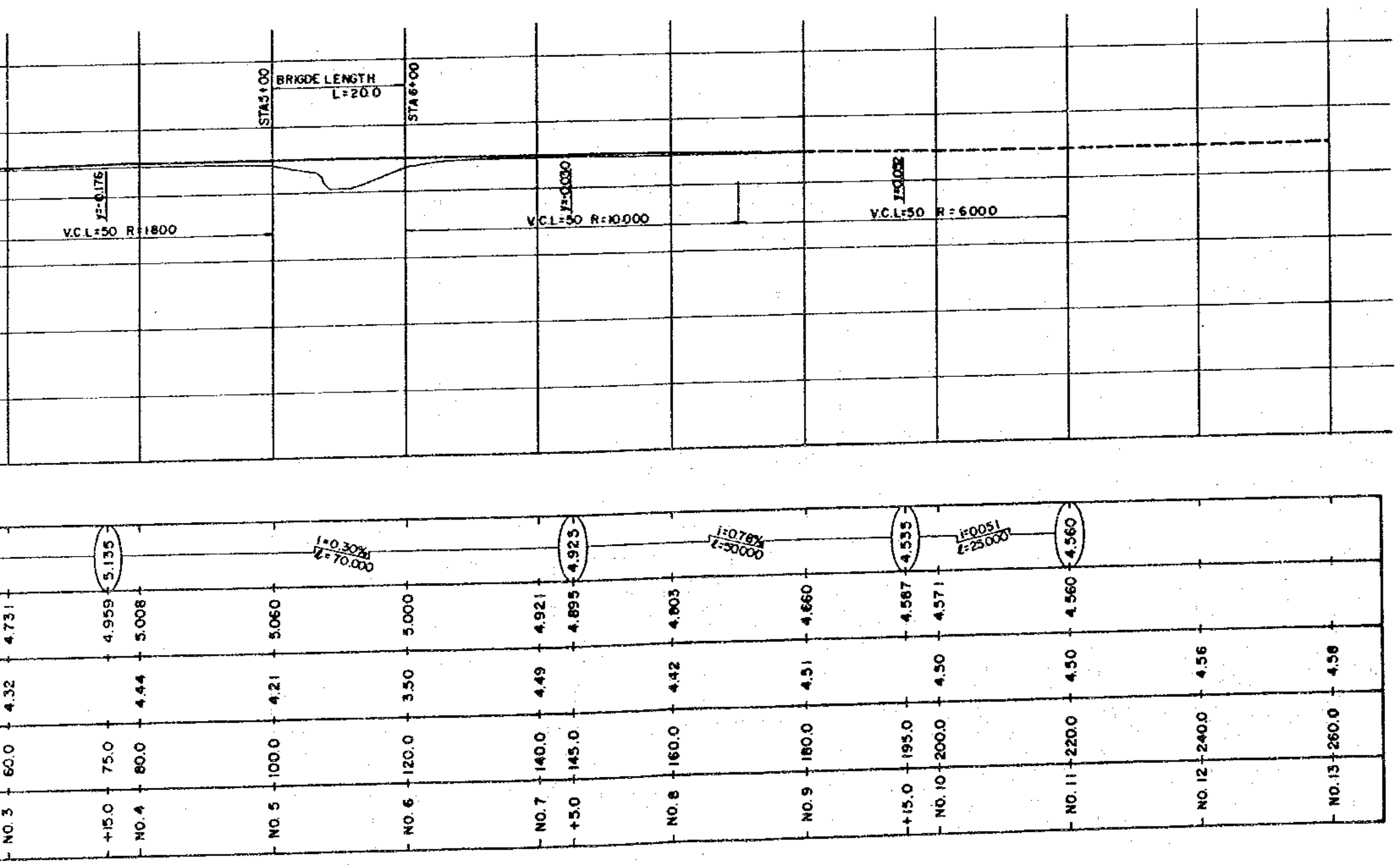
GRADE: i=1.00%; i=100% L=25.000; i=2.51% L=50000; i=0.30% L=70.000; i=0.76% L=50000; i=0.051 L=25000

Fig. 4.12 Approach Road (White River Bridge)

PLAN S = 1/1000

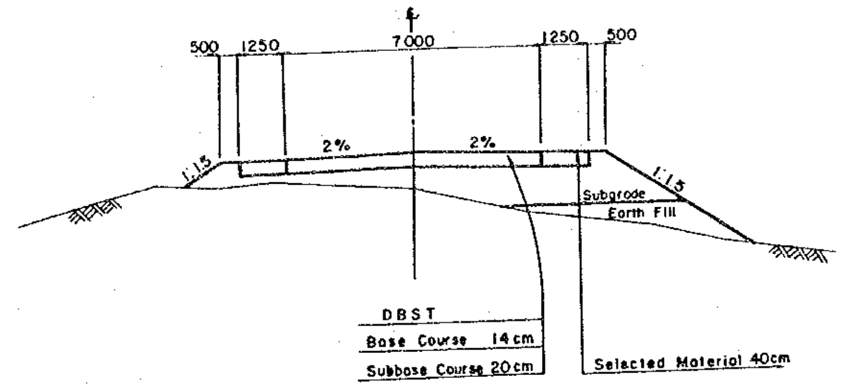


PROFILE S = 1/1000



TYPICAL CROSS SECTION S = 1/200

LEFT SIDE BANK



RIGHT SIDE BANK

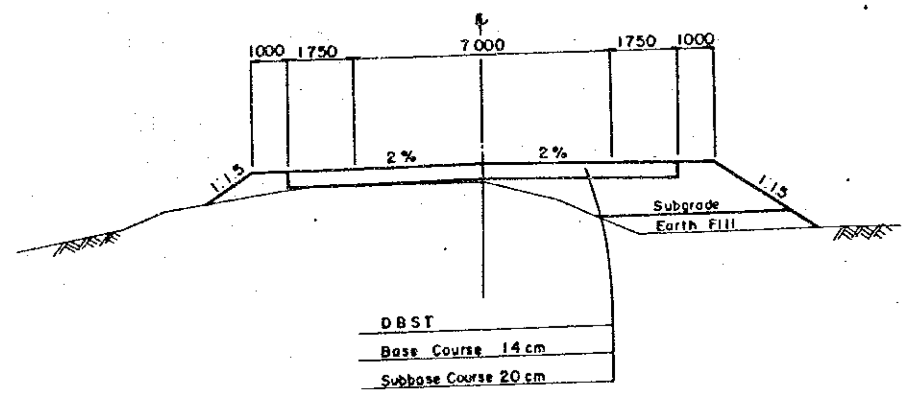
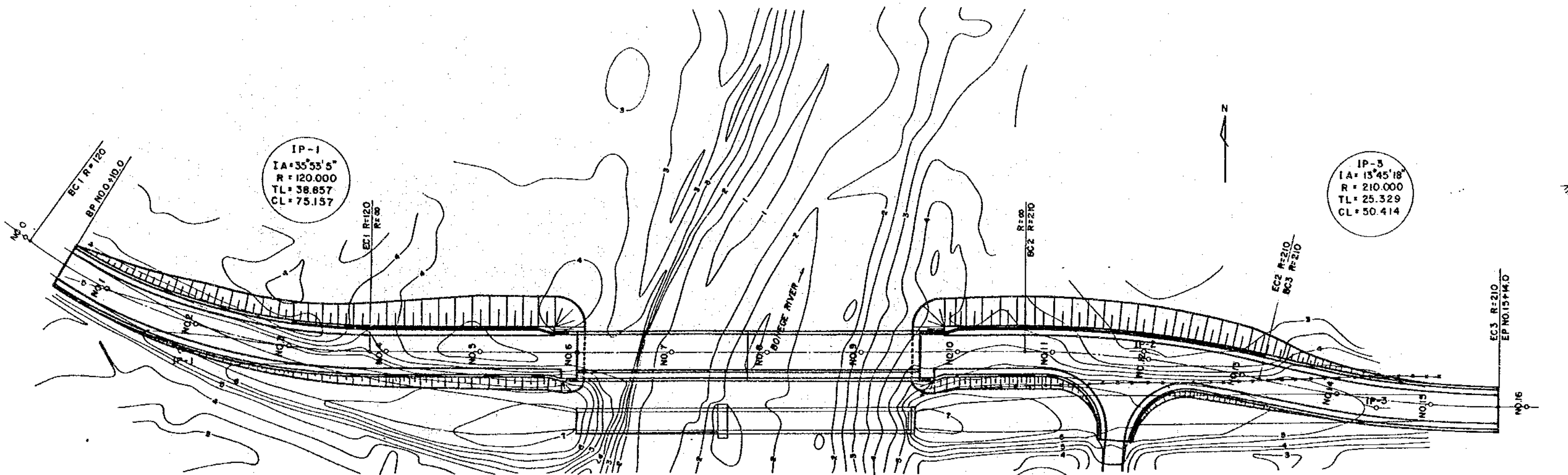
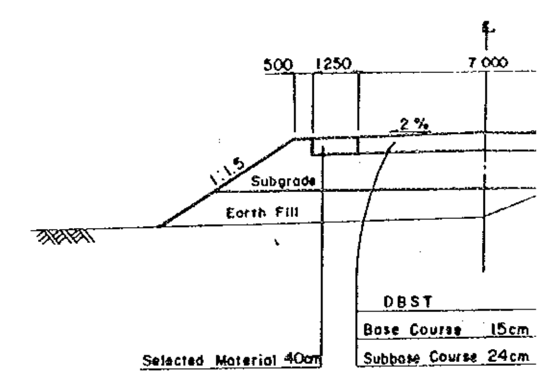


Fig. 4.13 Approach Road (Mbonege River Bridge)

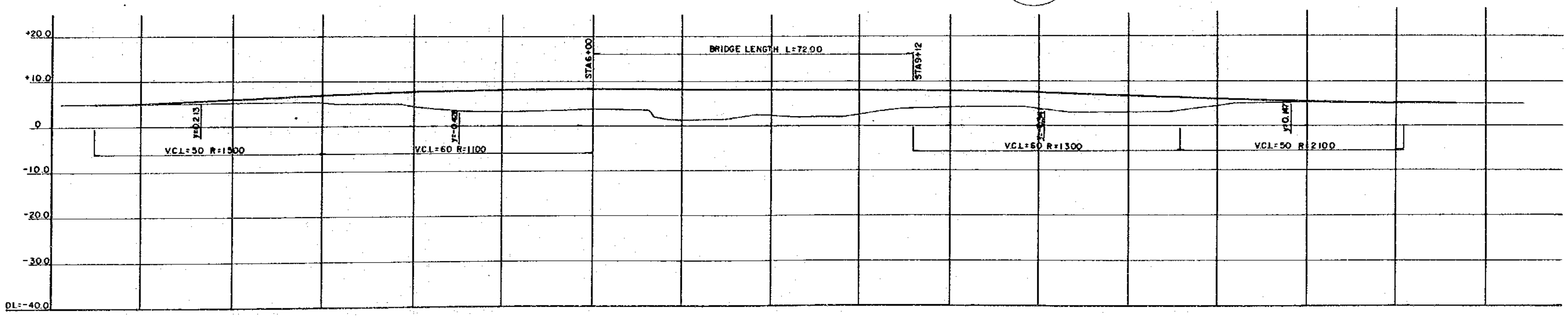
PLAN S = 1/1000



TYPICAL CROSS



PROFILE S = 1/1000

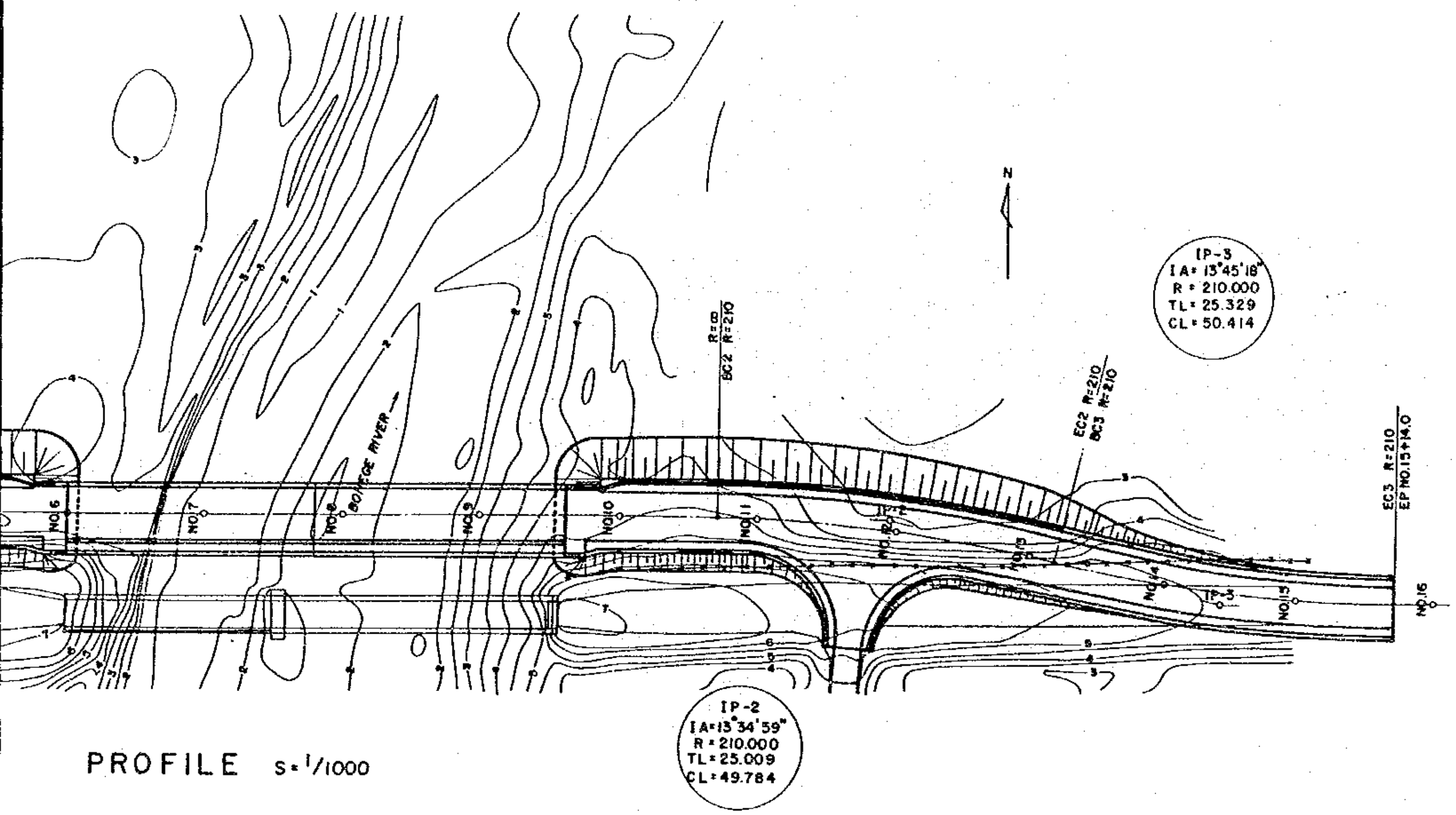


GRADE: I=2.00% — 4.830 — i=2.00% ℓ=25.000 — 5.330 — i=5.41% ℓ=55.000 — 8.306 — I=0.30% ℓ=132.000 — 7.910 — I=4.85% ℓ=55.000 — 5.245 — I=2.50% ℓ=37.000 — 4.320 — I=2.50%

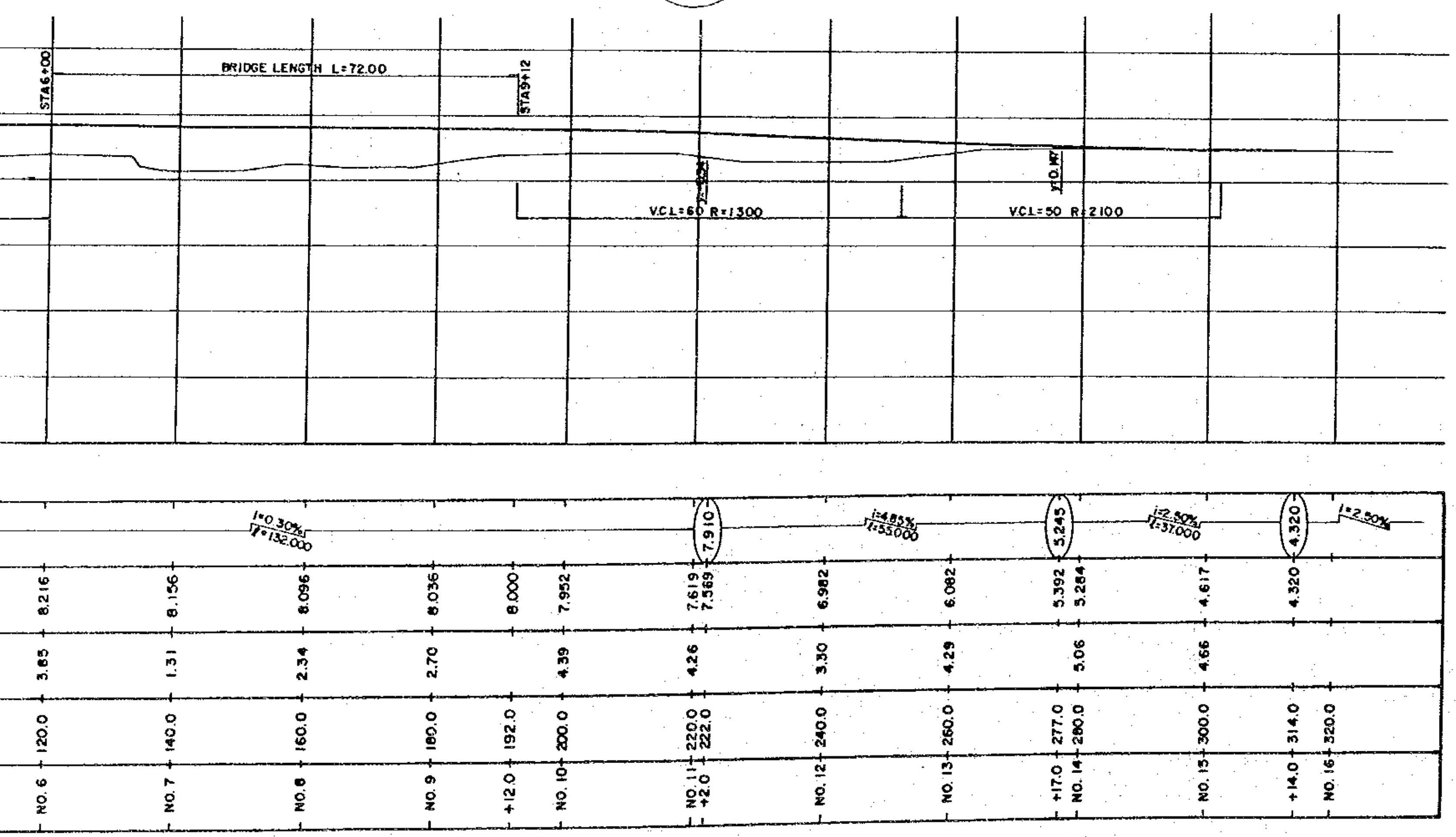
NO	ACC. DISTANCE	GROUND HEIGHT	PROPOSED HEIGHT
NO.0+10	10.00	4.830	4.830
NO.1	20.0	4.99	5.064
+15.0	35.0		5.543
NO.2	40.0	5.25	5.737
NO.3	60.0	5.25	6.683
NO.4	80.0	4.43	7.575
+10.0	90.0		7.878
NO.5	100.0	3.34	8.086
NO.6	120.0	3.85	8.216
NO.7	140.0	1.31	8.156
NO.8	160.0	2.34	8.096
NO.9	180.0	2.70	8.036
+12.0	192.0		8.000
NO.10	200.0	4.39	7.952
NO.11	220.0	4.26	7.619
+2.0	222.0		7.569
NO.12	240.0	3.30	6.982
NO.13	260.0	4.29	6.082
+17.0	277.0		5.392
NO.14	280.0	5.06	5.284
NO.15	300.0	4.66	4.617
+14.0	314.0		4.320
NO.16	320.0		

Fig. 4.13 Approach Road (Mbonege River Bridge)

PLAN s = 1/1000



PROFILE s = 1/1000



TYPICAL CROSS SECTION s = 1/200

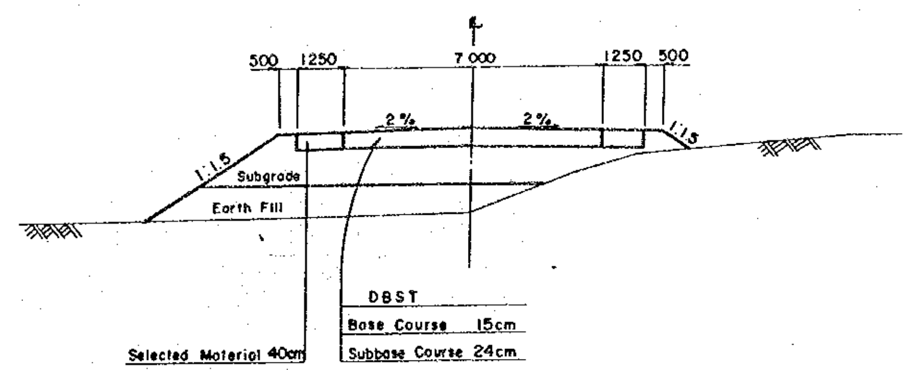
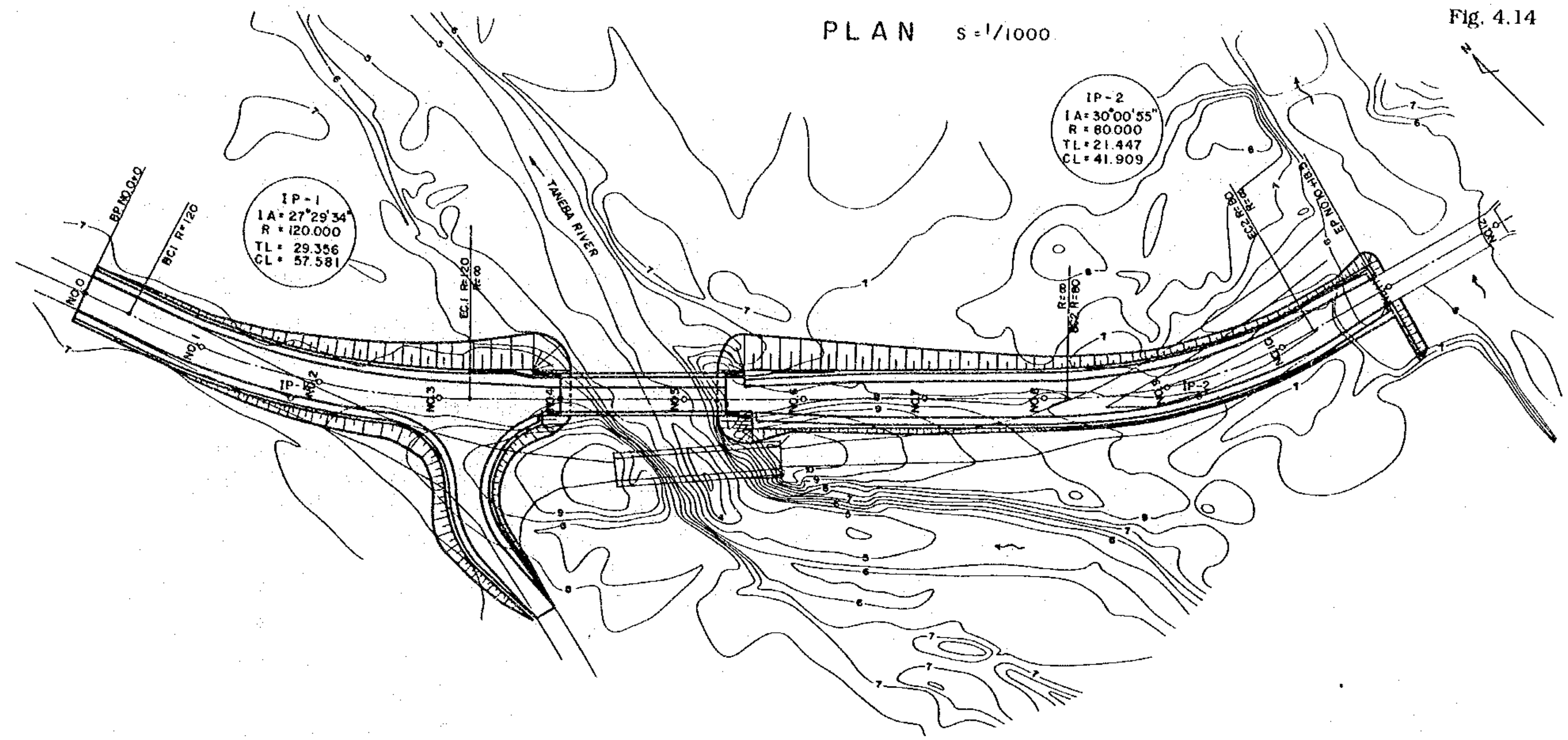


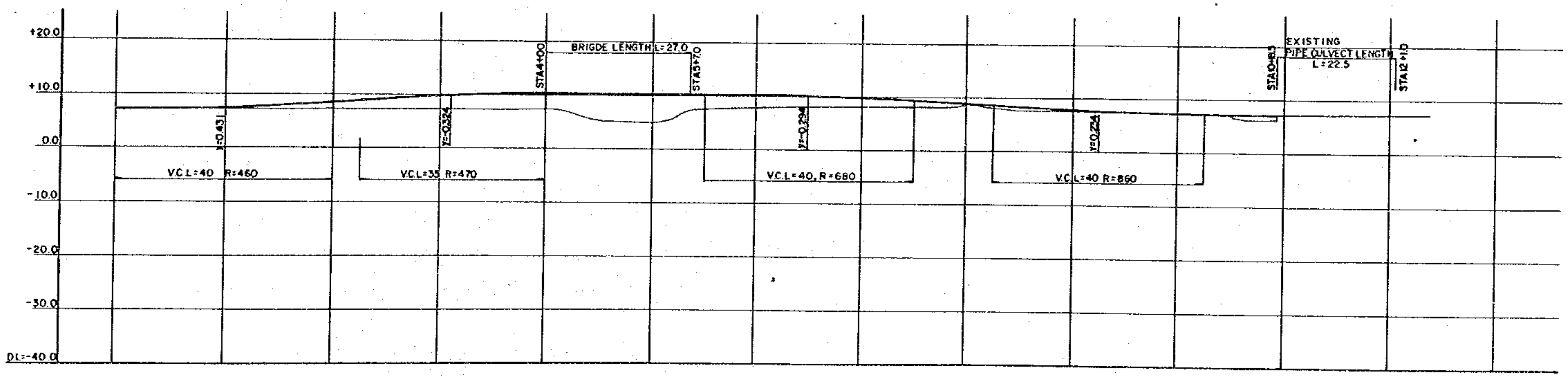
Fig. 4.14

Approach Road (Tanaemba River Bridge)

PLAN s=1/1000



PROFILE s=1/1000



NO	ACC. DISTANCE	GROUND HEIGHT	PROPOSED HEIGHT	GRADE
NO.0	0	7.15	7.150	7.150
NO.1	20.0	7.15	7.401	6.970
NO.2	40.0	7.24	8.512	
NO.3	60.0	7.05	9.817	
+2.5	62.5		9.924	10.248
NO.4	80.0	7.40	10.300	
NO.5	100.0	4.90	10.360	
+7.0	107.0		10.381	
NO.6	120.0	7.80	10.346	
+10.0	130.0		10.156	10.450
NO.7	140.0	7.98	9.819	
NO.8	160.0	8.50	8.779	
NO.9	180.0	7.38	7.802	
+5.00	185.0		7.620	7.386
NO.10	200.0	7.21	7.266	
+18.5	218.5		7.084	
NO.11	220.0	7.07	7.071	
+14.5	234.5		6.940	6.940
NO.12	240.0	7.05	7.045	
+7.50	247.5		7.187	7.187
NO.13	260.0	7.22		

Grade: i=0.90%; i=0.90% ℓ=20.000; i=7.70% ℓ=42.500; i=0.30% ℓ=67.500; i=5.57% ℓ=55.000; i=0.90% ℓ=49.500; i=1.90% ℓ=13.000

TYPICAL C

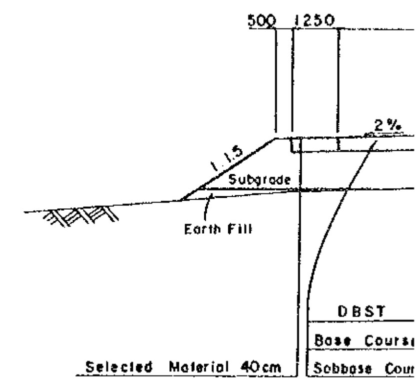
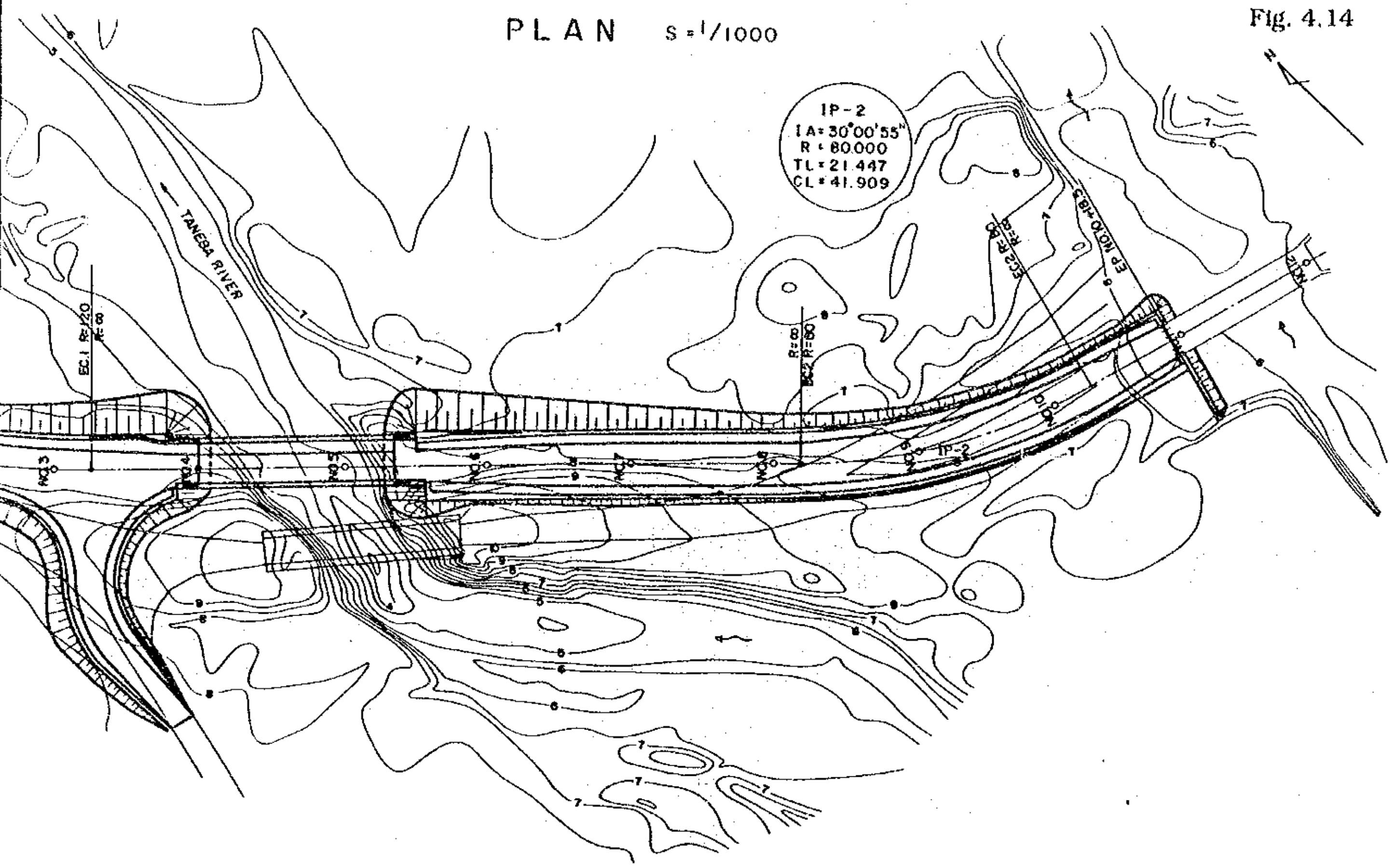
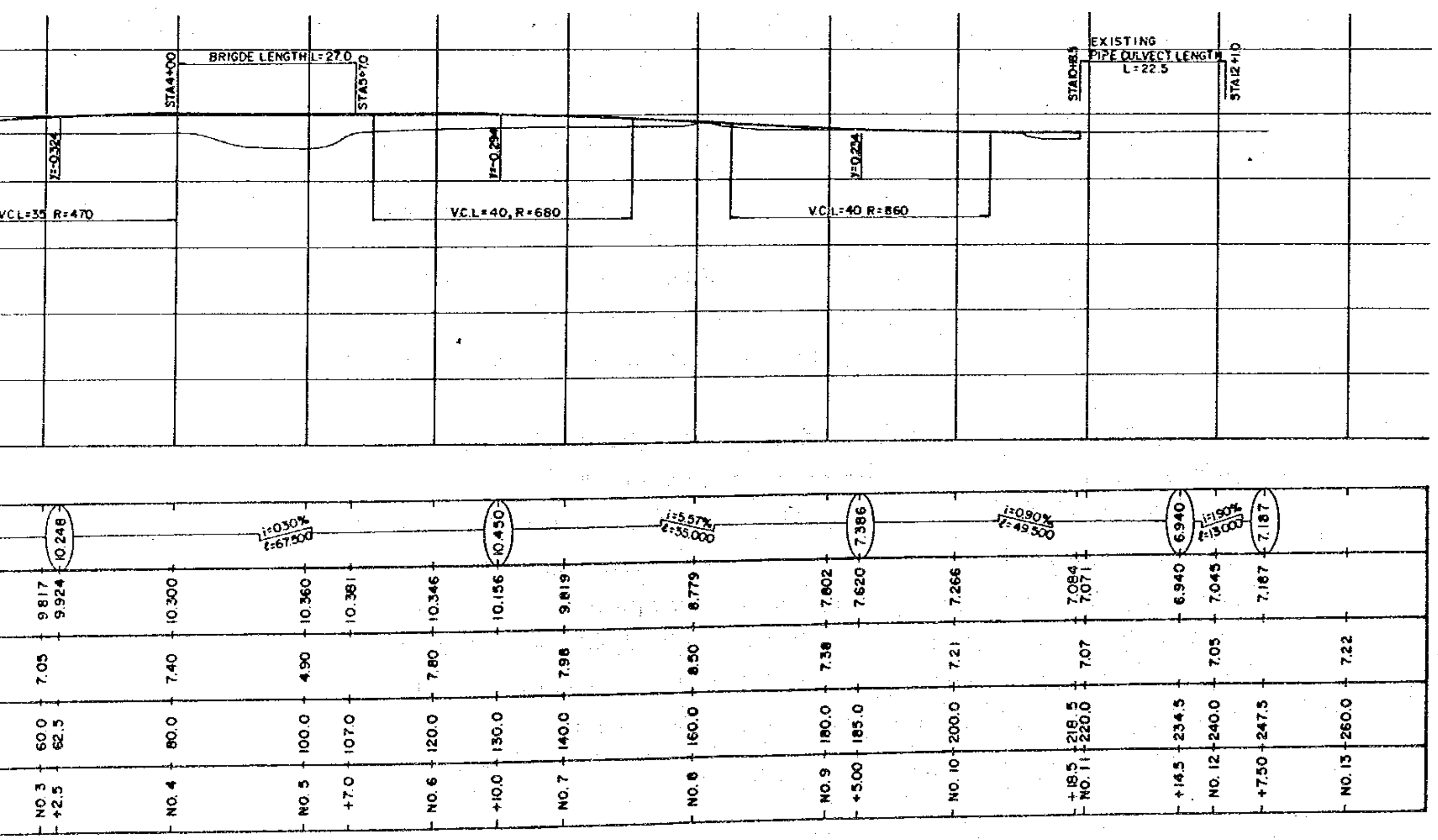


Fig. 4.14 Approach Road (Tanaemba River Bridge)

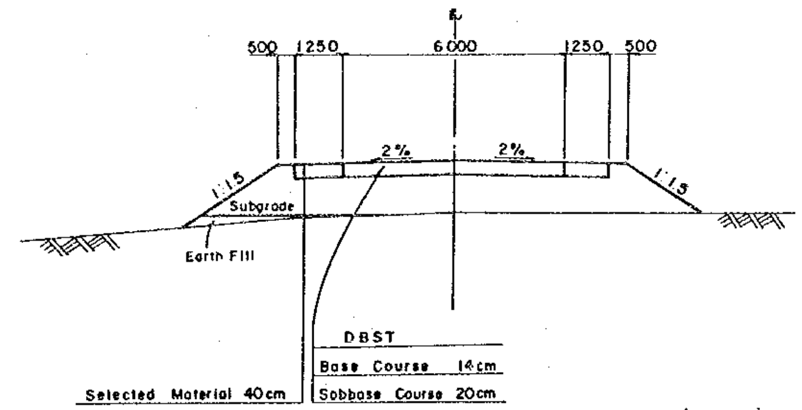
PLAN S=1/1000



PROFILE S=1/1000



TYPICAL CROSS SECTION S=1/200



structural drawings, so that there will be no misunderstanding as to the work to be accomplished.

4.6 Preliminary Bills of Quantities

Preliminary Design Quantities have been obtained for a preliminary cost estimated as follows:

Table 4.18 Preliminary Design Quantities

Description		Alligator Bridge	Metapono Bridge	White Bridge	Mbonege Bridge	Tanaemba Bridge
Bridge Area	(m^2)	582	497	242	748	186
Abutments	(No.)	2	2	2	2	2
Piers	(No.)	1	1	–	1	–
Steel Weight	(t)	94	86	62	128	27
Concrete	(m^3)	645	536	392	726	278
Reinf. Steel	(t)	80	69	43	93	33
Steel Pipe Pile	(m)	1320	670	672	666	448
Road Pavement Area	(m^2)	1,616	1,054	1,753	1,644	1,256
Earthwork	(m^3)	1,460	2,840	850	5730	2,650

4.7 Implementation Plan

4.7.1 Implementation Policy

The project consists of the replacing of the 5 bridges on the East-West Main Road on Guadalcanal Island which have the highest priority. The implementation of this project under the Grant Aid can be summarized as follows:

(1) The project is already designed for a shortened construction period, but it will not be possible to complete the project in a single fiscal year (within 12 months). Therefore, the project has been considered for implementation over two fiscal years, and for the 1st fiscal year the Alligator Creek Bridge (No. 1), and the Metapono River Bridge (No. 2); the remaining bridges of the White River Bridge (No. 7), Mbonege River Bridge (No. 9), and the Tanaemba River Bridge (No. 11) will be planned for implementation in the second year. There will be a period where the two fiscal years may overlap with each other.

(2) Due to the time planning, there could be 3 bridges construction being performed simultaneously with a minimum of 2 bridges being constructed at any one time. There could be work being performed on the substructure during the rainy season.

(3) In order to keep the construction costs low, the temporary construction materials will be planned to be shifted from project to project, and the construction equipment will be procured for the minimum requirements.

(4) The local labourers will be unskilled labourors, except for the skilled labourers. Hence the skilled labourers, foreman, and equipment operators will be imported from third countries.

(5) Since there is no university with engineering schools, there are only a few technicians with civil engineering training. Therefore, the supervisors to work under the Japanese managers will also be procured from third countries.

(6) For the skilled structural steel works requiring a high degree of accuracy, the necessary training supervisors; for the painting of steel with a high degree of all-weather type finishing coats, the necessary finishing instructors; and the operation required for the fuel operation of the minimum number of equipment; all these specialists will be brought in from Japan.

(7) The project sites will be east of Honiara at 3 km and 30 km, and west of Honiara at 4 km, 14 km, and 33 km, are far away from Honiara. For this reason, there will be several offices for the construction contractor and consultant established in Honiara where the infrastructures are set up, and the construction contractor's office at the construction sites.

(8) In order to make efficient use of the locally produced ready mixed concrete, concrete mixer trucks will be imported from Japan.

(9) Temporary construction roads will be provided for the contractor's heavy equipment to cross the rivers and perform their work (bridge foundation work and bridge beam work). This will help to prevent traffic congestion

on the existing bridges and prevent any bridge failures and assure the safety of the construction operations.

4.7.2 Construction Condition and the Matters to be considered in the Construction

(1) Construction Conditions

Other construction conditions underway in Guadalcanal are as follows:

The construction operations that have been performed in the city of Honiara are the National Insurance Fund Building (NPF, 6 stories), and the Solomon Islands National Bank Building (SINB, 5 stories), which are the representative buildings. For the other construction operations, there is the Selwyn College Campus Building at Marabobo (north of Tambea). The buildings under construction in Honiara City, are the National Parliament Building being built with funds from the United States, and a Shopping Center being built with private funds.

For civil engineering type of projects there are the recently completed facility of the Point Furm Port (rehabilitation) with ADB assistance and the Lungga Bridge with assistance from Japan.

The number of building projects is very few, and the projects in the Solomon Islands are small with financial assistance from foreign countries. These projects have generated the following construction activities.

1) There are 2 consultants and 5 construction contractors operating in the Solomon Islands, and are foreign contractors or under foreign management.

2) The construction materials produced in the Solomon Islands are lumber, sand, stone, soils, ready mixed concrete and concrete block with imported cement. The rock crushing plant is owned by the MTWU located in the suburbs of Honiara, and as there is no asphalt plant, flexible proving of DBST is presently used.

3) The construction materials available in the Solomon Islands are those related to road construction, owned by MTWU and leased to

construction companies (only one at present). For projects other than road construction projects, special equipment required are imported and taken off the island when their use is completed. The road construction equipment is limited as to their type and quantity.

(2) Points to Observe in Construction Works

This project is a bridge construction project, and the type of works will consist of steel beams and concrete deck work for the superstructure, and pile foundation and concrete abutments, and T-shaped bridge piers. Important materials and special skilled workmen will be imported from Japan and foreign countries. With the exception on one bridge, there are no houses at the bridge sites. For this reason, this bridge project is not a difficult one. However, as described in paragraph 4.7.1, Implementation Scheduling Policy, this project will be implemented as a Grant Aid, and the construction planning, the materials scheduling, the equipment scheduling, and the labour planning will require construction supervision by the consultant, and this will be the most important feature of this project.

4.7.3 Construction Management

(1) Basic Policy of Detailed Design and Construction Management

The basic policy of Detailed Design is as follows:

1) It will be best for the consultant who performed the Basic Design to perform the Detailed Design services. The reason for this is that the consultant who performed the Basic Design is fully acquainted with the design policy and will be able to complete the Detailed Design in a relative short time and realize savings in the project cost.

2) The necessary design data will be collected during the field survey when preparing the Detailed Design, and the Basic Design can be confirmed during this operation; the construction methods and cost data can be confirmed, and the desires of the client can be reflected in the detailed design drawings.

3) After the design operations for the Detailed Design has been completed, the contents of the work will be explained to the Government of Independent State of Solomon Islands, and discussions will be held.

The basic policy for the construction supervision will be as follows:

1) In accordance with the basic policy if item 1) above, the consultant who performed the Basic Design will perform the construction supervision.

2) Since there are no technicians with civil engineering knowledge, the construction management will be performed by Japanese engineers. However, the project presents an excellent opportunity for the few civil engineers of the MTWU to become acquainted with steel bridge techniques. The construction manager for the bridge construction operations will try to pass on their technology to the MTWU engineers.

3) The construction supervision engineers will be in accordance with the requirements of paragraph 4.7.3 (2) and endeavor to perform the "construction supervision operations" as smoothly as possible.

4) There will be 3 bridge construction operations constructed simultaneously, or at least 2 bridges constructed, and the construction operations will be separated, so the consultant's office and the construction contractor's general office will be provided in Honiara City.

5) The construction supervision system will be planned in accordance with the above conditions.

(2) Construction Supervisory System

The field of discipline, level of knowledge, and the number of Japanese engineers who will perform the construction supervision services will be as follows:

1) Overall Supervisor (JICA Grade 2nd Class), 1 Person

The overall supervisor will make spot checks at times of start of construction and completion of construction of each period.

2) Superstructure Engineer (JICA Grade 3rd Class), 1 Person per Period

The superstructure engineer will be dispatched for each period to make spot checks at the time of bridge truss crossing.

3) Substructure Engineer (JICA Grade 3rd Class), 1 Person per Period

The substructure engineer will be assigned permanently for the duration of each period.

4.7.4 Procurement Plan

(1) Procurement of Bridge Materials

Local materials that can be procured for the bridge construction will be procured from local sources as a general rule. However, when the quality of the material is questionable, or the volume in circulation will not permit the procurement in sufficient time, then the material will be obtained from Japan. Especially, factory manufactured steel bridge parts that have a short procurement period, or if the delivery of the material is doubtful, or the component part requires precision machining, they will be procured from Japan.

1) Materials Procured Locally

The following materials will be procured from local sources:

- Portland cement (imported)
- Ready Mixed Concrete (there is a shortage of concrete mixer trucks)
- Aggregates (sand, concrete aggregates, round stone, crushed aggregate)
- Reinforcing steel (available on the local market but there is a limit to the quantity available depending on size, cost is double that of Japan)

- Earth fill material
- Milled lumber, plywood
- Fuel oil, gasoline, lubricants (imported)

2) Materials to be imported from Japan

The following are the principal materials to be imported from Japan.

- Steel bridge components (factory manufactured)
- Temporary construction aids (steel sheet piling, H-beams, temporary cover steel sheets, scaffolding, tunnel supports)
- Protective fencing
- Bridge paints
- Reinforcing steel

(2) Procurement of Construction Equipment

Construction equipment is procured for the project and imported into the Solomon Islands on a project basis, and re-exported after the completion of the project, and for this reason the only equipment available for lease are road construction equipment and concrete mixers, and there are no bridge construction equipment available in the Solomons. The source of equipment are commercial leasing companies (only one company from field check), and the other source is the MTWU. However most of the MTWU equipment is leased out to other islands, and there is a time limit on their use. Table 4.19 and Table 4.20 indicates the local equipment and the main equipment that will have to be obtained from Japan.

Table 4.19 Main Equipment Procured Locally

Description of Equipment	Specification	Usage
Dump Truck	3 m^3	Road Construction
Truck	6 ton	Material Transport
Truck	12 ton, max. 12m hauling	Material Hauling
Bulldozer	Std. 15 ton	Clearing, Rooting, Road Construction
Shovel Tractor	Wheel Type, 3.5 m^3	Road Construction
Vibrating Roller	6 ~ 7 ton	Road Construction
Tire Roller	15 ton	Road Construction
Motor Grader	3.7 m blade	Road Construction

Table 4.20 Main Construction Equipment Procured in Japan

Equipment Description	Specs.	Q'ty	Usage
Crawler Crane	40 ton	2	Bridge Construction, Temporary Work
Pile Drive Leader	16 m	2	Substructure
Diesel Hammer	3.5 t	2	Substructure
Vibro-Hammer	60 kW	2	Substructure, Temporary Work
Truck Mtd. Crane	Pnm, 15 t	2	Super- & Substructure, Temporary Work
Dump Truck	11 ton	4	Earthwork
Concrete Mixer Truck	4.5 m^3	4	Concrete Work
Backhoe	0.6 m^3	2	Earthwork
Generator, Motor Driven	200 kVA	2	Super- & Substructure, Temporary Work

Note: Except for dump truck and truck-mixer, equipment will be required simultaneously at each site, hence 2 ea. dump truck and mixer truck was calculated from travel distance and quantities to haul.

(3) Material and Equipment Transportation Schedule

1) Locally Procured Materials

Stone, lumber, etc. procured from Honiara supplier will include delivery at work site. Ready-mix concrete and soils will be transported with trucks from Japan for the following reasons:

- Of the 2 concrete batch plants in Honiara, depending on the quality and capacity, the one closest to the job site will be selected (7 km east of Honiara). Presently the plant has 2 operational mixer trucks (4.5 m^3), and are used for medium sized projects in the city. The distance to the bridge sites are given in Table 4.21.

- The problem of land property in the Solomon Islands for construction projects has become difficult. For this reason quarries for fill materials are on Government owned land, and quarries are located between Lungga Bridge and the airport. Project schedule requires use of 11 ton dump trucks which are not available locally.

Locally leased construction equipment will include delivery to the job site by the leasing firm by their trucks and trailers.

Table 4.21 Hauling Distances

Bridge Site	From Honiara	From Concrete Plant
No. 1 Alligator	E - 14.1 km	7.1 km
No. 2 Metapono	E - 30.4 km	23.4 km
No. 7 White	W - 3.8 km	10.8 km
No. 9 Mbonege	W - 13.5 km	20.5 km
No. 11 Tanaemba	W - 33.0 km	40.0 km

2) Materials and Equipment to be Procured in Japan

The materials and equipment from Japan will be transported using the routes and delivery times:

Transport Routes		Time (Mons.)
Delivery, Ship Loading	Factory —> Port in Japan	0.5
Ocean Transport	Japan Port —> Honiara Port	0.5
Unloading, Customs Clr	Honiara Port	0.3
Inland Transport	Honiara Port —> Bridge Sites	0.2

For the ocean shipping, scheduled lines between Japan and the Solomon Islands (twice monthly) will be used. Inland transport in Guadalcanal will use local trucks and trailers. Longest trailer available is 12 m. Equipment transport is expected to be about 3 times. 1st time at signing of contract, 2nd at time of 1st shipping of steel girders, 3rd shipment will be made when the 2nd batch of steel girders are completed.

4.7.5 Implementation Schedule

This project will be implemented in two phases, and the project will be executed in accordance with the design, tendering, construction/construction supervision schedule. Table 4.22 is the Implementation Schedule.

(1) Detailed Design

The Detailed Design will be performed by the consulting engineer who has signed the design contract with the Government of Independent State of the Solomon Islands. The contract will consist of the detailed drawings, bill of quantities, construction cost estimate, tender documents including the technical specifications, prepared in two phases. The completed documents will require the approval of the Government of Independent State of the Solomon Islands.

Table 4.22 Implementation Schedule

		Month	1	2	3	4	5	6	7	8	9	10	11	12
Phase 1	Detailed Design		□	□	□	□								
Phase 1	Tendering						□	□						
Phase 1		Month	1	2	3	4	5	6	7	8	9	10	11	12
Phase 1	Phase 1		■	■	■	■	■	■	■	■	■	■	■	■
Phase 1	Alligator Creek Bridge	Preparatory Work	■	■								■		
Phase 1	Alligator Creek Bridge	Substructure		■	■	■	■	■						
Phase 1	Alligator Creek Bridge	Superstructure							■	■	■	■		
Phase 1	Alligator Creek Bridge	Approach Road					■	■	■					
Phase 1	Metapono River Bridge	Preparatory Work				■	■							■
Phase 1	Metapono River Bridge	Substructure					■	■	■	■				
Phase 1	Metapono River Bridge	Superstructure									■	■	■	■
Phase 1	Metapono River Bridge	Approach Road										■	■	■
Phase 1	Fabrication of Girders		□	□	□	□	□							
		Month	1	2	3	4	5	6	7	8	9	10	11	12
Phase 2	Tendering		□	□										
Phase 2		Month	1	2	3	4	5	6	7	8	9	10	11	12
Phase 2	Phase 2		■	■	■	■	■	■	■	■	■	■	■	■
Phase 2	White Creek Bridge	Preparatory Work	■	■							■			
Phase 2	White Creek Bridge	Substructure		■	■	■	■	■						
Phase 2	White Creek Bridge	Superstructure							■	■	■			
Phase 2	White Creek Bridge	Approach Road								■				
Phase 2	Mbonege River Bridge	Preparatory Work		■	■									■
Phase 2	Mbonege River Bridge	Substructure			■	■	■	■	■					
Phase 2	Mbonege River Bridge	Superstructure								■	■	■	■	■
Phase 2	Mbonege River Bridge	Approach Road				■	■	■	■	■	■			
Phase 2	Tanaemba River Bridge	Preparatory Work						■	■					■
Phase 2	Tanaemba River Bridge	Substructure							■	■	■	■		
Phase 2	Tanaemba River Bridge	Superstructure										■	■	■
Phase 2	Tanaemba River Bridge	Approach Road										■	■	
Phase 2	Fabrication of Girders		□	□	□	□	□							

(2) The Tendering Enquiry

The tendering for the project will be performed by the consultants for the Government of Independent State of the Solomon Islands in Japan in accordance with the phases, and will consist of the following:

- Receipt of the contractors requesting prequalification
- Evaluation of the contractors and preparation of Short List of Tenderers
- Holding of meetings with Tenderers for Question/Answer Session
- Receipt, opening of tenders, and evaluation of tenders
- Evaluation meeting, and award of Contract, and notifying the successful tenderer

(3) Construction/Construction Supervision

After signing of the Contract, the approval of the Japanese Government will be obtained, and the works will be commenced. The construction operations will consist of the preparation of the construction site (clearing of site), bridge foundation works, bridge superstructure works, approach road works, and the fabrication of the steel bridge components in Japan. The 1st phase will consist of the Alligator Creek Bridge (No. 1), and the Metapono River Bridge. The 2nd phase will consist of the White River Bridge (No. 7), Mbonege River Bridge (No. 9), and the Tanaemba River Bridge (No. 11). Each phase will require 12 months to complete.

The construction operation will require the following construction supervision works to be performed by the Consultant.

- Approval of the Construction Schedule and the Construction Drawings
- Construction Schedule
- Quality Control
- Inspection of Completed Construction Works
- Issue of Certification as requested by by the Construction Contractor
- Submittal of Reports
- Other Procurement Matters

4.7.6 The Share to be borne by the Both Government

The implementation of the project under the Grant Aid of the Japanese Government will require the share of some of the works between the Japanese Government and the Government of Independent State of the Solomon Islands as described hereinafter. The details are described in attached "Minutes of Discussions".

1) The Share to be borne by the Japanese Government

- Construction of the new bridge
- Construction of minimum length of approach road
- Construction roads required for the project (bridge) works, and the installation of temporary buildings and the removal thereof.
- The materials required for the above construction works and the procurement of labor required (including the transportation of materials and equipment)
- Field management costs for the above construction works
- The necessary consultant's services to implement the works

2) The Share to be borne by the Government of Independent State of the Solomon Islands

- Removal of the existing bridge facilities
- The removal and reconnection of the water pipe and communication cables to be installed at the new bridge site, and construction works required at completion of the works
- Acquisition of the construction sites, and the land necessary to perform the temporary work
- The disposal of prexploded shells and bombs found at the construction sites
- The exemption of tax on the materials and equipment imported for the project, and the expeditions processing of the custom procedures
- The exemption of custom fees for the Japanese and 3rd party nationals entering the Solomon to work on the project, and exemption of other financial obligations

Chapter 5 Project Evaluation and Conclusion

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

5.1 The Effects of the Project

- Implementation of the project will permit the East-West Main Road, with Honiara at its center, to maintain its function to make use of the total length of 154 km, and contribute to the improvement of the daily lives of the 81,000 people of the Guadalcanal Islands, especially the 30,500 residents of Honiara.

  Implementation of the project will connect the densely populated regions of Guadalcanal Island with an all weather road, and will help to stabilize their daily living.

- After completion of the project, there will not be any maintenance and operation required for the roads and bridges and this will enable Solomon Islands to educate and train their own personnel to maintain, operate, and administrate the facilities with their own funds.

- This project will become one of the important infrastructures in the future development of projects for the Solomon Islands.

- This project will be performed under the Grant Aid of the Japanese Government, and the project can be performed without any difficulties.

5.2 Conclusion

With the implementation of this project, as described hereinbefore, far-reaching effects can be realized, while contributing to the upgrading the level of living of the residents, and it is determined that the project is justified as a Grant Aid project. After the project has been completed, the personnel and funds for the maintenance and operation of the facilities will not be necessary for several years, and the it will allow the Government of the Solomon Islands to procure the personnel and funds during this time.

5.3 Recommendation

After the completion of the project, the bridges reconstructed will be permanent structures, the bridges can be utilized to keep their functions when the maintenance is performed well.

It will be recommended to establish the maintenance system as soon as possible recognizing the importance of this matter in tropical areas.

It will be recommended that land acquisition of the sites of the reconstruction of the five bridges and their approach roads will be proceed prior to the commencement of the Project.

APPENDICES

List of Appendices

A-1 Members of the Study Team

The Study Team consists of a Team Leader, a Project Coordinator and five (5) Technical Experts as follows:

- Team Leader

Name	:	Mr. Yorimichi MAEKAWA
Present Post	:	Advisory Officer, Construction Division, Hanshin Expressway Public corporation

- Project Coordinator

Name	:	Mr. Katsuhiro SASAKI
Present Post	:	Deputy Director, Second Basic Design Study Division, Japan International Cooperation Agency (JICA)

- Project Coordinator

Name	:	Mr. Eiji IWASAKI
Present Post	:	Second Basic Design Study Division Japan International Cooperation Agency (JICA)

- Technical Experts

Name	Assignment
Mr. Satoshi WATABE	Chief, Bridge Planner
Mr. Kazuo MORIYA	Bridge Designer
Mr. Shuichi YUMOTO	Transport Planner
Mr. Sakae TAKADA	Natural Conditions Surveyor
Mr. Kazuo MIZUKOSHI	Execution Planner

A-2 Schedule of the Study Team

Field Investigation (November 25 to December 29, 1992)

Date (1992)		Activities
November 25	(Wed.)	M/S Watabe/Yumoto/Mizukoshi/Moriya from Narita arrived in Honiara. Courtesy call on Japanese Embassy.
November 26	(Thu.)	Explanation of contents and tentative schedule of the field survey for MTWU, Ministry of Foreign Affairs and PDU.
November 27	(Fri.)	Field Survey (West Side of Honiara)
November 28	(Sat.)	Field Survey (East Side of Honiara) Study on the results of the field survey.
November 29	(Sun.)	Study on the results of the field survey.
November 30	(Mon.)	Discussion on the results of the field survey.
December 1	(Tue.)	Study on the result of the field survey traffic count.
December 2	(Wed.)	M/S Maekawa/Sasaki from Narita arrived in Honiara. Courtesy call on Japanese Embassy. Discussion with Team members.
December 3	(Thu.)	Courtesy call on the Minister of MTWU. Discussion with MTWU/MOFA/PDU Field survey.
December 4	(Fri.)	Field survey. Data collection. Study on the results of the field survey and data collection.
December 5	(Sat.)	Study on the collected data.
December 6	(Sun.)	Study on the collected data.
December 7	(Mon.)	Discussion with MTWU/MOFA/PDU.
December 8	(Tue.)	Field survey with Solomon Islands Government Officers.
December 9	(Wed.)	Study on the collected data.
December 10	(Thu.)	Discussion with MTWU/MOFA/PDU.
December 11	(Fri.)	Sign for Minutes of Discussion. Explanation to Japanese Embassy.

December 12	(Sat.)	M/S Maekawa/Sasaki/Yumoto left Honiara for Narita.
December 13	(Sun.)	Mr. Takada arrived in Honiara.
December 14	(Mon.)	Meeting with Police for the Investigation of unfired bomb. Data collection.
December 15	(Tue.)	Field survey, Data collection.
December 16	(Wed.)	Field survey, Investigation of unfired bomb, Data collection.
December 17	(Thu.)	Field survey, Investigation of unfired bomb, Data collection.
December 18	(Fri.)	Field survey, Investigation of unfired bomb, Data collection.
December 19	(Sat.)	Field survey, Data collection.
December 20	(Sun.)	Field survey.
December 21	(Mon.)	Field survey, Investigation of unfired bomb. Discussed with MTWU Explanation of the results of the field survey to Japanese Embassy.
December 22	(Tue.)	Field survey, M/S Watabe/Moriya/Mizukoshi left Honiara for Narita.
December 23	(Wed.)	Field survey (Boring).
December 24	(Thu.)	Field survey (Boring).
December 25	(Fri.)	Study on the collected data.
December 26	(Sat.)	Study on the collected data.
December 27	(Sun.)	Field survey.
December 28	(Mon.)	Field survey (Boring).
December 29	(Tue.)	Mr. Takada left Honiara for Narita.

D/F Report Explanation (April 7 to April 18, 1993)

Date (1993)		Activities
April 7	(Wed.)	M/S Maekawa/Iwasaki/Watabe/Moriya from Narita arrived in Honiara.
April 8	(Thu.)	Courtesy call on Ministry of Foreign Affairs, Ministry of Transport Works & Utilities and Japanese Embassy.
April 9	(Fri.)	Field survey and data arrangement.
April 10	(Sat.)	Field survey and data arrangement.
April 11	(Sun.)	Data arrangement.
April 12	(Mon.)	Field survey and data arrangement.
April 13	(Tue.)	Explanation of Draft Final Report for Ministry of Transport Works & Utilities and Australian High Commission
April 14	(Wed.)	Field survey with Ministry of Agriculture & Lands
April 15	(Thu.)	Discussion of Draft Final Report for Ministry of Transport Works & Utility, Ministry of Foreign Affairs, Ministry of Agriculture & Lands and Ministry of Housing & Government
April 16	(Fri.)	Minutes of Discussion on Ministry of Transport Works & Utilities, Courtesy call on Ministry of Housing & Government and Japanese Embassy
April 17	(Sat.)	Data arrangement
April 18	(Sun.)	M/S Maekawa/Iwasaki/Watabe/Moriya left Honiara for Narita

A-3 List of Interviewed Person

Ministry of Transport,Works & Utilities

Mr. Hon. Ben Gale	Minister
Mr. Daniel Ho'ota	Permanent Secretary
Mr. Martin Wale	Chief Civil Engineer
Mr. Tom Krawczyk	ILO Expert on Rural Roads
Mr. Tastre Ataria	Principal Works Officer, Mechanical
Mr. Anderson Konahe	Surveyor
Mr. John Ta'aru	Chief Mechanical Engineer
Mr. Samuel Marsden	Under Secretary
Mr. Paia Maezama	

Ministry of Foreign Affairs & Trade Relations

Mr. Eliam Tanirono	Deputy Secretary
Mr. Fred Fakarii	Chief of Asian Section
Mr. Wilson Ifunaoa	Permanent Secretary

Ministry of Provincial Government

Mr. Johnson Airau	Director of the Provincial Development Unit (PDU)
Ms. Ethel Sigimanu	Deputy Director of PDU
Mr. Francis Orodani	Chief Physical Planner, Guadalcanal Province
Mr. Amon Pale	Planning Officer, Guadalcanal Province

Office of Prime Minister

Ms. Ruby Titiulu	Assistant Secretary, Policy Evaluation Unit

Ministry of Finance & Economic Planning

Mr. David Abboti	Macroeconomic Advisor
Mr. Joseph Naesol	Government Statistician
Mr. Allan M. Fiku	Senior Statistician

Ministry of Agriculture and Lands

Mr. Steve Likaveke	Physical Planning Division
Mr. Harry Sosimo	Principal Lands Officer
Mr. Gabroel Alaalia	Cartographer
Mr. David Bapirongo	Second Land Valuer

Ministry of Natural Resources

Mr. Nicholas Biliki	Geologist
Mr. Allison K. Papabaru	Seismology Section

Ministry of Tourism & Aviation

Mr. D. Kew	Meteorological Service Division

Ministry of Police & Justice

Mr. Stepherd Lapo	Chief Inspector, Head of Police Field Force, Police Headquarters Rove

Ministry of Housing & Government Service

Mr. M.D. Sogavare	Commissioner of Inland Revenue

A－4 MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT FOR RECONSTRUCTION OF GUADALCANAL PLAINS BRIDGES IN SOLOMON ISLANDS

In response to a request from the Independent State of Solomon Islands, the Government of Japan decided to conduct a Basic Design Study on the Project for Reconstruction of Guadalcanal Plains Bridges (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Solomon Islands a study team headed by Mr.Yorimichi MAEKAWA, Advisory Officer, Construction Division, Hanshin Expressway Public Corporation, and is scheduled to stay in the country from November 25 to December 29, 1992.

The team held discussions with the officials concerned of the Government of Solomon Islands and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets, The team will proceed to further works and prepared the Basic Design Study Report.

Honiara, December 11, 1992

Yorimichi MAEKAWA
Leader
Basic Design Study Team
JICA

Daniel Ho'ota
Permanent Secretary
Ministry of Transport, Works and Utilities

ATTACHMENT

1. Objective

The objective of the Project is to reconstruct bridges on main road for providing uninterrupted road transport in the Guadalcanal plains and North Guadalcanal bridges and contributing toward the enhancement of the nation's economy.

2. Project Site

The location of the Project sites is shown Annex I.

3. Executing Agency

Ministry of Transport, Works and Utilities(MTWU) is responsible for the implementation of the Project.

4. Items Requested by the Government of the Solomon Islands

After discussion with the Basic Design Study Team, the following items were finally requested by the Solomon Islands side.

(1) Name of Bridges to be constructed are as follows, (in order of priority)

① White River Bridge
② Metapono River Bridge
③ Mbonege River Bridge
④ Tanaemba River Bridge

The Solomon Islands side requested to include "Alligator Creek Bridge" as a project site and give higher priority on it.

(2) Improvement of the approach roads to connect with the bridges.

(3) Design Criteria

MTWU has confirmed that the design criteria for bridges specified in the Specification for Highway Bridge of Japan will be adopted to conduct the design of the bridge reconstruction.

However, the final components of the Project may differ from the above description, if it is judged necessary after further studies.

5. Japan's Grant Aid System

(1) The Solomon Islands side has understood the system of Japan's grant aid explained by the team.

(2) The Government of the Solomon Islands will take necessary measures, described in Annex II and III for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Porject.

6. Schedule of the Study

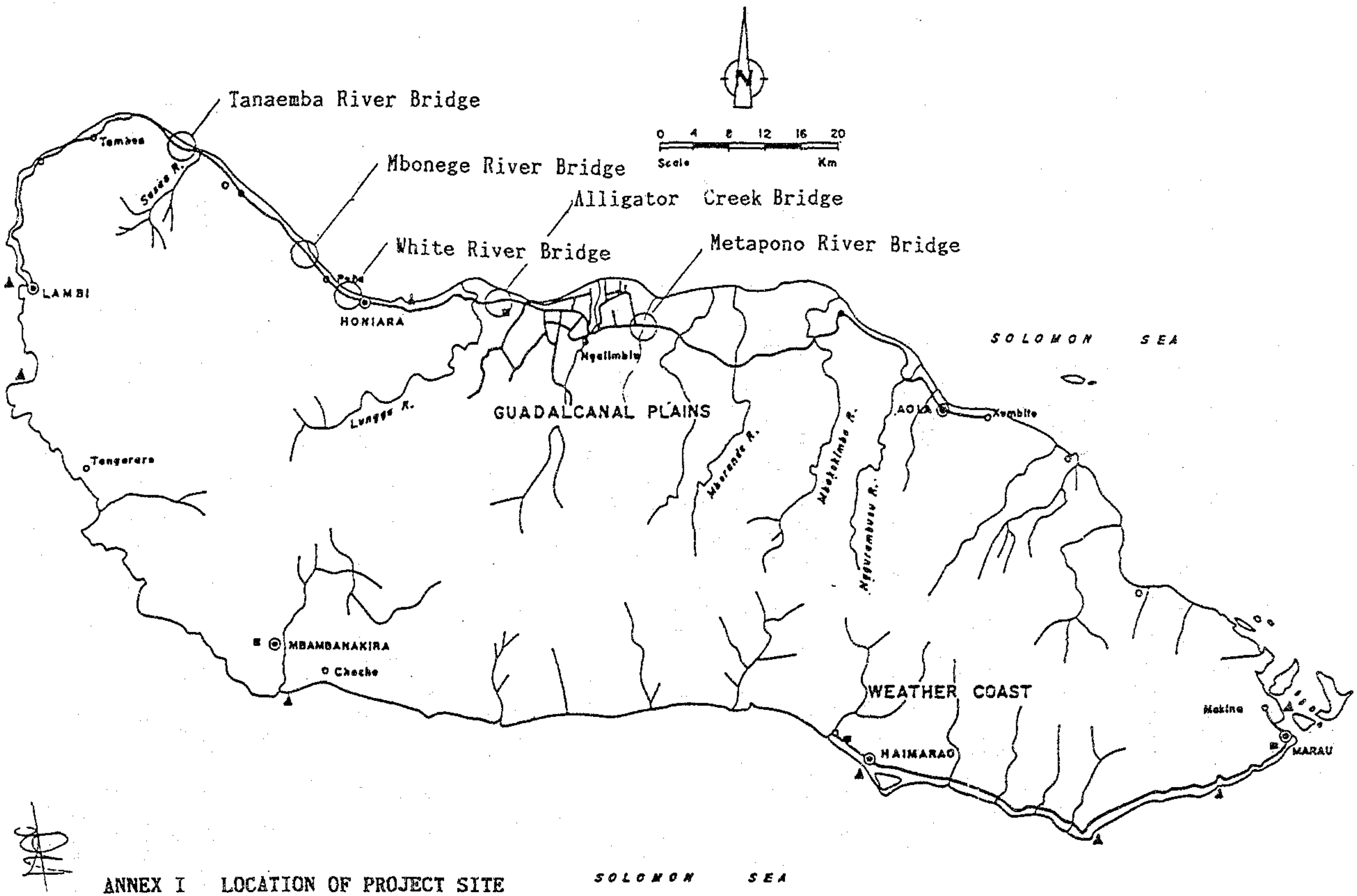
(1) The consultants will proceed to further studies in the Solomon Islamds until December 29, 1992.

(2) The Study Team wil prepare the draft final report and will be sent to explain it until April 1993.

(3) Based on the agreed and confirmed items in the Minutes of Discussions and technical examination of the study results, JICA will finalize the report and send it to the Solomon Islands side by the end of May, 1993.

7. Exemption of Tax

The Solomon Islands side ensured to take necessary measures to exempt General Sales Tax(GST), which comes into force in March 1993, imposed to raw materials and fuels purchased in the Solomon Islands for the Project.



ANNEX I LOCATION OF PROJECT SITE

ANNEX II PARTICULAR UNDERSTANDINGS TO BE TAKEN BY THE SOLOMON ISLANDS SIDE FOR THE PROJECT

No.	Items	to be Covered by the Solomon Islands side
(1)	Land acquisition and property compensation for the reconstruction of bridges prior to the commencement of the Project	O
(2)	Land lease/acquisition of the spaces for the base camps (office, quarters, stock yard and motor pool), aggregates processing and mixing plant and other necessary temporary works	O
(3)	Demolition and clearing of the inhabitant's properties within the right-of-way area along the approach roads, as required	O
(4)	Reconstruction of the approach roads (when needed)	O
(5)	Control of road traffic during the reconstruction	O
(6)	To inform the objective of the Project to inhabitant around project site and obtain consent from them before implementation of the Project	O
(7)	Removal of the existing bridge	O
(8)	To rearrange the public utilities, such as city water line and telephone line, etc.	O
(9)	To sweep underground miss-fired explosives on the project area and secure the safty of the implementation of the Project.	O

ANNEX III NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE SOLOMON ISLANDS IN CASE JAPAN'S GRANT AID IS EXECUTED

1. To secure the site for the Project.

2. To clear, level and reclaim the site prior to commencement of the construction.

3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lightning in and around site.

4. To construct the access road to the site prior to commencement of the construction.

5. To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to the Project site.

   1) Electricity distribution line to the site
   2) City water distribution main to the site
   3) Drainage city main to the site
   4) Telephone trunk line to the main distribution panel of building
   5) General furniture such as carpet, curtains, tables, chairs and others

6. To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

7. To exempt taxes and take necessary measures for customs clearance of the material and equipment brought for the project at the port of disembarkation.

8. To ensure prompt unloading and customs clearance at port of disembarkation and internal transportation therein of the products purchased under the Grant.

9. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into the Solomon Islands and stay therein for the performance of their work.