NATIONAL ROAD AMINISTRATION
MINISTRY OF PUBLIC WORKS AND HOUSING
THE REPUBLIC OF MOZAMBIQUE

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR RECONSTRUCTION OF BRIDGES ON THE MAIN NATIONAL ROADS II
IN
THE REPUBLIC OF MOZAMBIQUE

December, 1999

JAPAN INTERNATIONAL COOPERATION AGENCY

CHODAI CO., LTD
NIPPON KOEI CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of Mozambique, the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Bridges on the Main National Roads II and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to Mozambique from May 27 to Jun 6, 1999 and from Jun 30 to August 8, 1999.

The team held discussions with the officials concerned of the Government of Mozambique, and conducted field studies at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Mozambique in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Mozambique for their close cooperation extended to the team.

December, 1999

Kimio Fujita
President
Japan International Cooperation Agency

December,1999

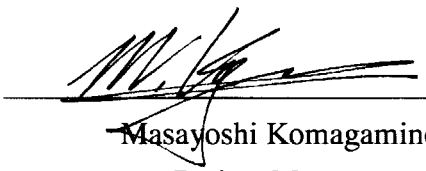
Letter of Transmittal

We are pleased to submit you the basic design study report on the Project for the Reconstruction of the Bridges on the Main National Roads II in the Republic of Mozambique.

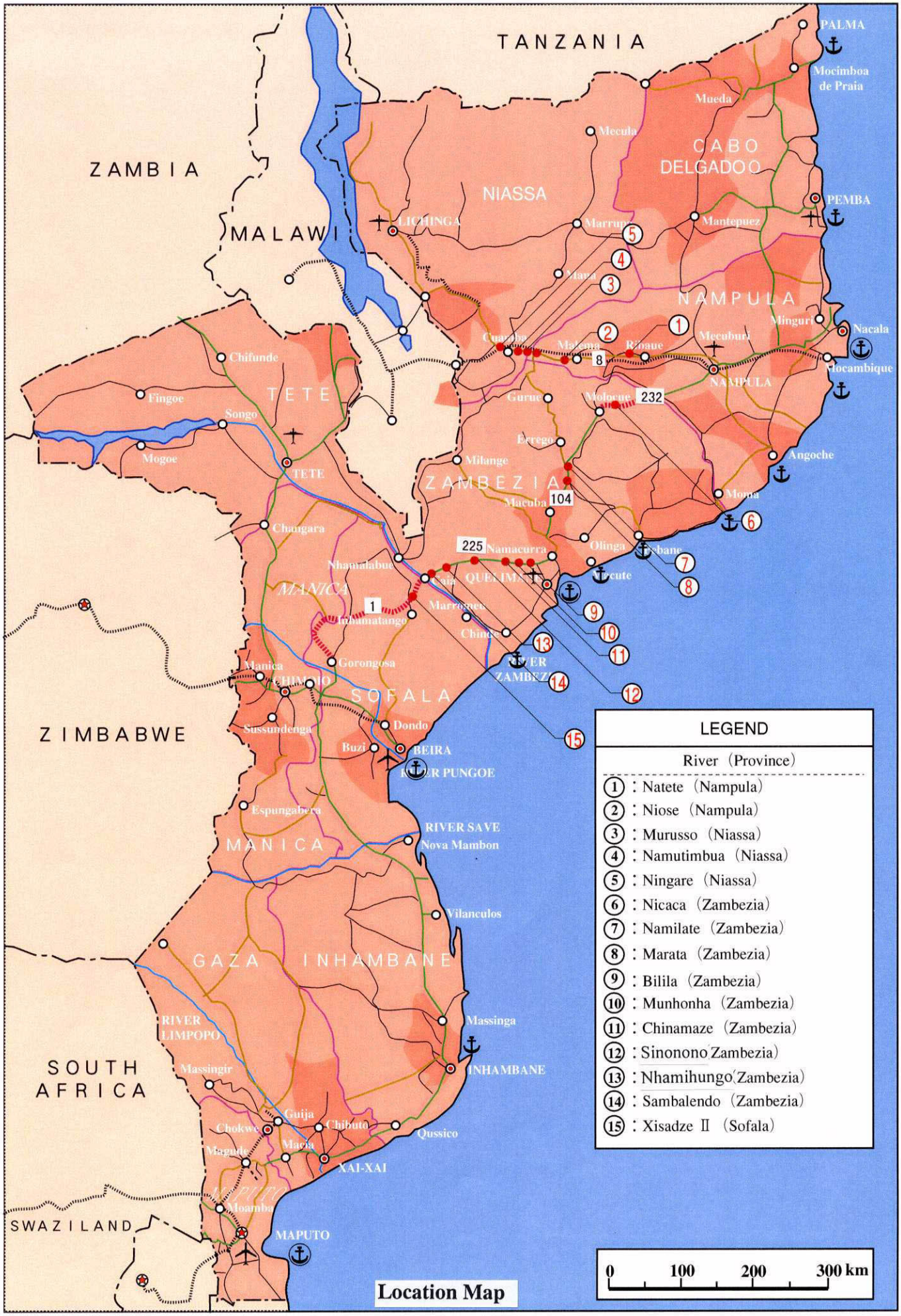
This study was conducted by Chodai Co., Ltd. and Nippon Koei Co., Ltd. under a contract to JICA, during the period from May 14,1999 to January 21, 2000. In conducting the study, we have examined the feasibility and rationale of the Project with due consideration to the present situation of Mozambique and formulated the most appropriate basic design for the Project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the Project.

Very truly yours,



Masayoshi Komagamine
Project Manager
Basic design Study Team on the Project
For Reconstruction of Bridges on
The Main National Roads II
In the Republic of Mozambique


TANZANIA
ZAMBIA
MALAWI
ZIMBABWE
SOUTH AFRICA
SWAZILAND
NIASSA
CABO DELGADO
NAMPULA
ZAMBEZIA
TETE
MANICA
SOFALA
GAZA
INHAMBANE
PALMA
Mocimboa de Praia
Mueda
Mecula
PEMBA
LICHINGA
Marrupa
Montepuez
Mavaca
Minguri
Nacala
Cuamba
Malema
Mecuburi
Chifunde
Fingoe
Songo
Mogoe
TETE
Gurue
Moloque
232
Errego
Milange
Angoche
Maculuba
104
Mocuba
Changara
225
Namacurra
Olinga
Nhamalabua
QUELIMANE
Caia
Marromeu
Chinde
Manica
CHIMOIO
Gorongosa
Sussundenga
Dondo
Buzi
BEIRA
RIVER PUNGOE
Espungabera
RIVER SAVE
Nova Mambon
Vilanculos
Massinga
INHAMBANE
RIVER LIMPOPO
Massingir
Guija
Chokwe
Chibuto
Qussico
Magude
Maoa
XAI-XAI
Moamba
MAPUTO
LEGEND
River (Province)
① : Natete (Nampula)
② : Niose (Nampula)
③ : Murusso (Niassa)
④ : Namutimbua (Niassa)
⑤ : Ningare (Niassa)
⑥ : Nicaca (Zambezia)
⑦ : Namilate (Zambezia)
⑧ : Marata (Zambezia)
⑨ : Bilila (Zambezia)
⑩ : Munhonha (Zambezia)
⑪ : Chinamaze (Zambezia)
⑫ : Sinonono Zambezia)
⑬ : Nhamihungo(Zambezia)
⑭ : Sambalendo (Zambezia)
⑮ : Xisadze Ⅱ (Sofala)
0 100 200 300 km
Location Map

Ningare Bridge

Nigare Bridge (Close Up)

Abbreviations

Authorities and Agencies

ANE	:	National Road Administration
DNEP	:	Directorate of National Roads and Bridges
ECMEP	:	State Enterprise for Construction and Maintenance of Roads and Bridges
EEC	:	European Economic Community
FRELIMO	:	Frente de Libertaçae de Moçambique
IDA	:	International Development Association
JICA	:	Japan International Cooperation Agency
MOFAC	:	Ministry of Foreign Affairs and Cooperation
MOPH	:	Ministry of Public Works and Housing
SIDA	:	Swedish International Development Agency
SATTC	:	Southern African Transport and Communication Commission
RENAMO	:	Resistancia de Nacionale de Moçambique
USAID	:	United States Agency for International Development

Other Abbrebiations

AHP	:	Analytic Hierarchy Process
A/P	:	Authorized to Pay
B/A	:	Bank Arrangement
BHN	:	Basic Human Needs
ODA	:	Official Development Assistance
PRN	:	National Reconstruction Plan
ROCS	:	Roads and Coastal Shipping Project
TT25t	:	25ton Truck Load

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Chapter 1 Background of the Project

The Republic of Mozambique has total population of 16.54 million in 1997. The country, of which area is 0.8 million km^2 , is located south-east coast of African Continent facing Indian Ocean and surrounded by Tanzania, Malawi, Zimbabwe, Zambia, Swaziland and South Africa.

The country extends over 2,000km from north to south and 1,200km from east to west. Border length is 4,330km and coast line is 2,600km and the country is widely divided into three by the Zambezi river and the Save river.

Population of the country is concentrated in coastal area such as Cabo Delgado, Nampula, Zambezia, Sofala, Inhanbane and Maputo provinces where large cities and towns are located.

Recent population increment ratio from 1990 to1997 is 1.7% annually due to the increment of death rate by HIV etc. and is decreasing from the same ratio of before 1990 which was 2.7%.

From immediately after the independence from Portugal in 1975, the country entered in the civil war between socialism government FRELIMO and resistant party RENAMO for 17years, involving eastern and western block as well as neighbor countries objecting socialism, until both side reached agreement of cease fire.

Because of this war, about 1.5million people had escaped to neighbor countries as refugees, country's economy was hovered around and many social infrastructure facilities, including road and bridge, were destroyed.

By the starting of negotiation for cease fire in 1990, country's name has been changed to the Republic of Mozambique and redevelopment of the country such as resettlement of refugees, disarmament of soldiers, promotion to return to be farmers etc. has started.

Following to the stabilization of country's situation, in order to reconstruct important social infrastructure destroyed by the war, financial support from donor countries in the world lead by IDA and ECC has been being made to date.

However, most of major important social infrastructures were destroyed due to prolonged war thus the fund for reconstruction is insufficient to cover them. Because of this, in 1994 the Government of Mozambique requested to the Government of Japan to give an assistance for the reconstruction of major 21 bridges among those which were destroyed or deteriorated on the main national roads.

The Government of Japan responded to the request and conducted basic design study for 13 bridges selected from 21bridges in 1996 and has implemented the construction of them from August 1996 which scheduled to be completed in March 2000.

Besides the above, there still be many bridges to be reconstructed or repaired on the main national roads and in addition to the bridges under reconstruction and in order to improve road traffic and transport, the Government of Mozambique has newly requested to the Government of Japan to give an assistance to reconstruct 17bridges on the same route of No.8, No.232, No.104, No.225 and No.1.

Chapter 2 Contents of the Project

2-1 Objectives of the Project

The objective of this project is to supplement for the reconstruction of 13 bridges currently carried out under "The Project for Reconstruction of Bridges on the Main National Road" financed by the Japanese grant aid and to eliminate the obstructions of road traffic by reconstructing 15 bridges selected this time.

Among the main national highway routes, No.8 is an important international corridor to connect between Mozambique and Malawi known as the Nakara Corridor and No.232, 104, 225 and 213(1) are the important roads as a part of north–south link. The project is also aiming to contribute for the economical development of the region by the increment of commodity and peoples flow borne by a smooth road transport

2-2 Basic Concept of the Project

2-2-1 Selection of Bridges

The Number of bridge requested by Mozambican side was 17 and it is necessary to determine whether these bridges are necessary to be rehabilitated and are suited for Japanese grant aid or not. All the 17 bridges are investigated in the 1st site survey and determined based on the result of the study with following three factors.

1. Bridge located on the main road and temporary (bailey bridge) or permanent.
2. Bridge with lack of bearing capacity due to a damage or a deterioration or not.
3. Bridge located on the same route as the Project prescribed in **2-1** or not.

As a result, 15 bridges, among 17 bridges requested by the Mozambican Government, to be investigated in the 2nd study, were selected and marked in circle as shown in Table-2-1.

Table-2-1 Selection of Bridges

Bridge Name	Temporary	Damage	Route	Judgement
1. Natete	○		○	○
2. Niose	×	○	○	○
3. Mitakathine	×	×	○	×
4. Murusso	○		○	○
5. Namutimbua	○		○	○
6. Ningare	○		○	○
7. Nicaca	–		○	○
8. Namilate	○		○	○
9. Marata	○		○	○
10. Bilila	○		○	○
11. Munhonha	○		○	○
12. Chinamaze	○		○	○
13. Sinonono	○		○	○
14. Namihungo	○		○	○
15. Sambalendo	○		○	○
16. Xisadze II	○		○	○
17. Guenjere	○		×	×

Location of 15 bridges is as shown in Fig-2-1.

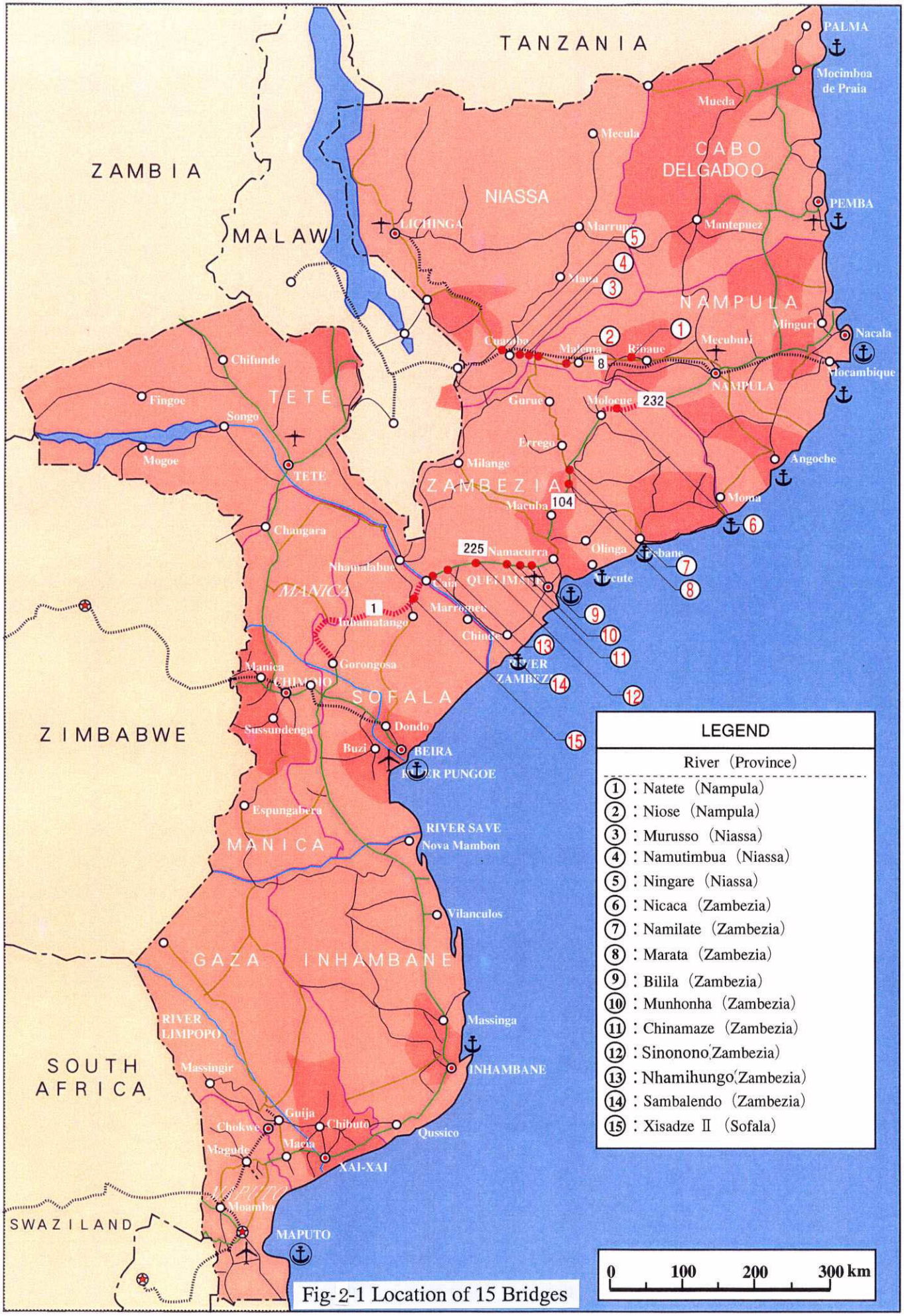


Fig-2-1 Location of 15 Bridges

2-2-2 Evaluation of Bridges

In order to determine the priority of construction and a design grade, evaluation was carried out to 15 bridges investigated. The evaluation was made for the priority of route based on the social environment and the priority of reconstruction based on the existing condition of each bridge.

As for social environment, the priority of reconstruction was evaluated by using Analytic Hierarchy Process (AHP) method. Following four factors are used as the indexes for judging a priority of routes.

1.Development Plan along the Route
2.Socio-Economic Condition
3.Traffic Volume
4.Relation with Social Development of the Area

In addition to the above, following five factors are also used as the indexes for judging the priority of bridge on the same route since the above factors are normally used only for judging the priority of routes.

1.Bridge Type : 0~30 points
2.Bridge Opening : 0~20 points
3.Structural Damage : 0~20 points
4.Carriageway Width : 0~10 points
5.Sub-structural Condition : 0~20 points

The result of evaluation is as shown i n Table-2-2.

Table-2-2 Evaluation Result

Bridge Name	Route Priority	Priority of Reconstruction					Judgement
		Bridge Type	Bridge Opening	Damage Rate	Width	Foundation	
Natete	0.268	30	10	0	10	20	19
Niose	0.268	20	0	20	0	20	16
Murusso	0.268	30	20	0	10	20	21
Namutimbua	0.268	30	10	0	10	20	19
Ningare	0.268	30	10	0	10	20	19
Nicaca	0.263	30	20	20	10	20	26
Namilate	0.263	30	10	0	10	10	16
Marata	0.263	30	10	0	10	10	16
Bilila	0.187	30	20	10	10	20	17
Chinamaze	0.187	30	20	10	10	20	17
Munhonha	0.187	30	20	10	10	20	17
Sinonono	0.187	30	20	10	10	20	17
Namihungo	0.187	30	10	10	10	20	15
Sanbalendo	0.187	30	10	10	10	10	13
Xisadze II	0.281	30	10	10	10	10	20

2-3 Basic Design

2-3-1 Design Concept

(1) Natural Conditions

In Mozambique, except for over 1,000m height, the weather is the tropical with 1,200~2,000mm annual rainfall in the northern area and is the semi tropical with 400~600mm annual rainfall in the southern area. The amount of rainfall fluctuates depending on year thus the country is affected by a natural disaster such as drought and flood alternately.

There is a clear distinction of dry and wet season; the dry season is from April to September with the average temperature of 13~24℃ in July and the wet season is from October to March with the average temperature of 22~31℃ in February.

The country is formed from low land along the coast, northern terrain and western terrain. The low land occupies 44%, the northern terrain occupies 29%, and the western terrain occupies 27% of the total land. Total number of the main river is 25 and the country is widely divided into three zones by the Zambezi and the Save rivers.

(2) Social Conditions

Immediately after the independence in 1975, the country entered in civil war of between FRELIMO and RENAMO for 17 years involving the eastern block and the western block. Due to the war, the country had fallen into poor and poverty condition due to the destruction of social infrastructures.

Most of the road network had been deteriorated and over 50% of the secondary road and over 70% of the tertiary road became passable only at the dry season. Approximately 40% of shops had been destroyed or forced to close. About 1,500 units of trucks and buses had been destroyed and the balance 13,000 units of heavy vehicles held serious problems on maintenance and operation. Pace of reconstruction at urban area seems to be relatively fast however, the same seems to be slow at countryside.

(3) Construction Conditions

In Mozambique, there is no contractor who has ability to construct civil structure such as middle to long span bridge. The government sector has no such ability too and the situation is to have to rely on the contractors from neighbor countries such as South Africa etc.

Except for low quality of cement, sand and gravel, construction material is difficult to procure and also, except for up to middle size earth moving equipment, construction equipment is difficult to procure in the country. Consequently, the major construction materials and equipment necessary to construct such a civil structure have to be procured through neighbor countries or from Japan.

(4) Ability for Maintenance and Management of the Implementation Agency

The National Road administration (ANE) is given an independent management fund from the government and is possible to arrange his budget for maintenance and management by himself. ANE has close relationship with the Enterprise for

Construction and Maintenance of Road and Bridge (ECMEP). ECMEP holds certain number of equipment and personnel for maintenance work of bridge and road through out the country and is carrying out maintenance of major bridges and roads, except trunk road, by providing their own personnel.

(5) Scope of Design

The scope of the design is limited for 15 bridges and access road at both sides of the bridges.

(6) Construction Period

There is 4 month's continued wet season with heavy rain in the country and during the period the efficiency of the work is drastically dropped. Thus the working period is limited as 8 months in a year. Further, it is considered as the most effective to build 15 bridges by two parties.

As the result, taking the above facts into consideration, the total construction period required is estimated at 36months.

2-3-2 Basic Design

(1) Basic Policy of Basic Design

1) Cross Section of Bridge and Road

a. Bridge : Two carriage ways of 3.6m width and foot way of 1.2m in width at both side. (Fig-2-2)

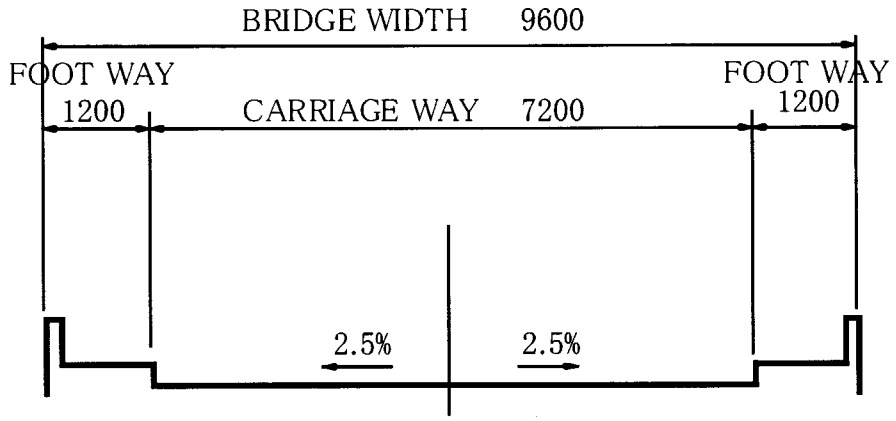


Fig-2-2 Bridge Section

b. Road : Two carriage ways of 3.6m width and shoulder of 1.0m in width at both side.(Fig-2-3)

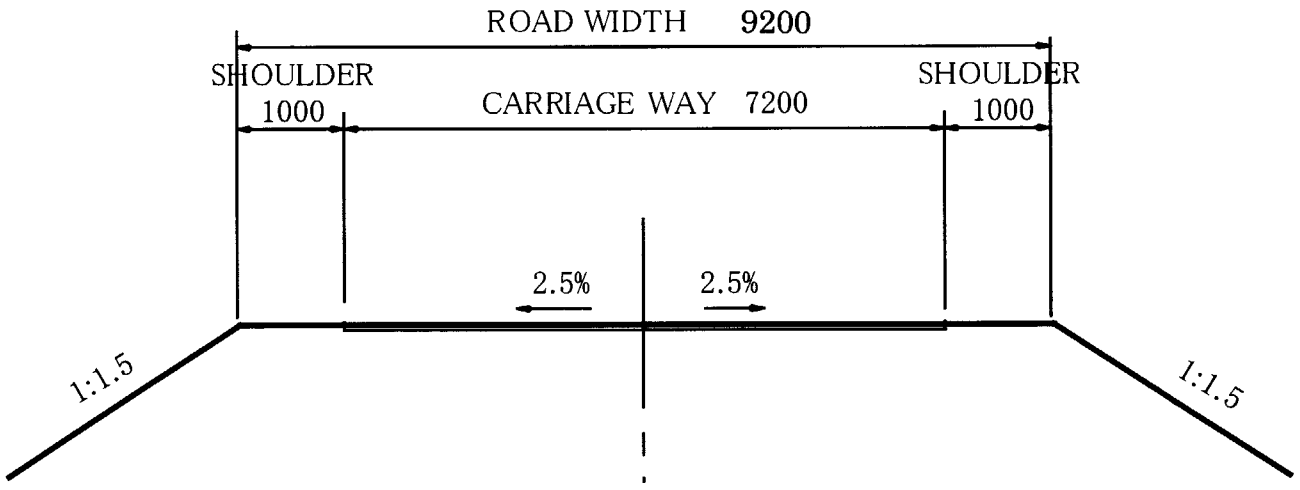


Fig-2-3 Road Section

2) Structural Plan

Both of super-structure and sub-structure types were selected by the following standard by utilizing of the aggregates usually available locally.

Most of the road on this project run through hill side to avoid low and wet land therefore, hard strata which becomes the bed of foundation is found at relatively

shallow depth. Due to the fact, in principle, foundation type is selected from either direct foundation or RC pile foundation depends on the depth of the bed.

a. Standard for selecting Super-structure

- Aggregate for concrete which requires mass transport shall be procured near from the site.
- Reinforced concrete structure, which does not require high grade of construction technique, and is lower cost, is adopted as much as possible.
- In case longer span than 18m is required due to the site condition, pre-stressed concrete structure is adopted since the span length is beyond the limit of reinforced concrete structure.

b. Standard for selecting Sub-structure

- Simple type structure shall be adopted as much as possible.
- Negative T shape Abutment is selected for the Abutment.
- Wall type Pier which is the most simple structure is selected for the Pier.

3) Determination of River Condition

Including both the re-utilization of the existing structure and new bridge construction, hydrological study was conducted to all the 15 bridges. Bridge opening of each bridge was determined based on the result of this hydrological study, as well as geographical condition and river condition.

The result of the study is as shown in Annex-1.

4) Slope Protection and River Bed Protection

In order to protect bridge and access road from damage caused by river water, slope protection and riverbed protection are planned.

Slope protection is provided not only against river water but also against heavy showers to a danger of slope erosion. There are various kinds of slope protection such as glassing, retaining wall, stone pitching, sack gabion etc. however, the maintenance work is carried out by the Mozambican side, the most appropriate method shall be studied. And as the result, it was so decided that reed is to be planted to the slope in stead of glass and sack gabion, which is commonly used in the country, is to be laid at the toe of slope.

As regard to riverbed protection, the protection is unnecessary to provide, where direct foundation is planned, however, on the other hand the protection is necessary to provide, where piled foundation is planned and there is a tendency of scouring due to river flow. The type of protection may be sack gabion.

5) Re-utilization of the Existing Structure

In order to reduce construction costs, reutilization of the existing structure was planned. The bridge which abutment is strong and sound but slab was fallen or damaged due to some reasons such as Namilate and Marata on Route104, Sambalendo on Route225 and Xisadze II on Route1, abutment itself is re-utilized as it is with the rectification of upper part of structure to receive new slab. And at Niose on Route8, slab and pier are re-utilized as it is and only abutment with wing wall is

rectified.

6) Design Load

TT25t load of the Japanese Standard is used for the structural design however, as a checking load, NA, NB and NC load specified by the Southern African Transport and Communication Commission (SATTC) shall be used to determine the safety of structure.

Table-2-3 shows the plan of each bridge decided based on the result of the above basic policies.

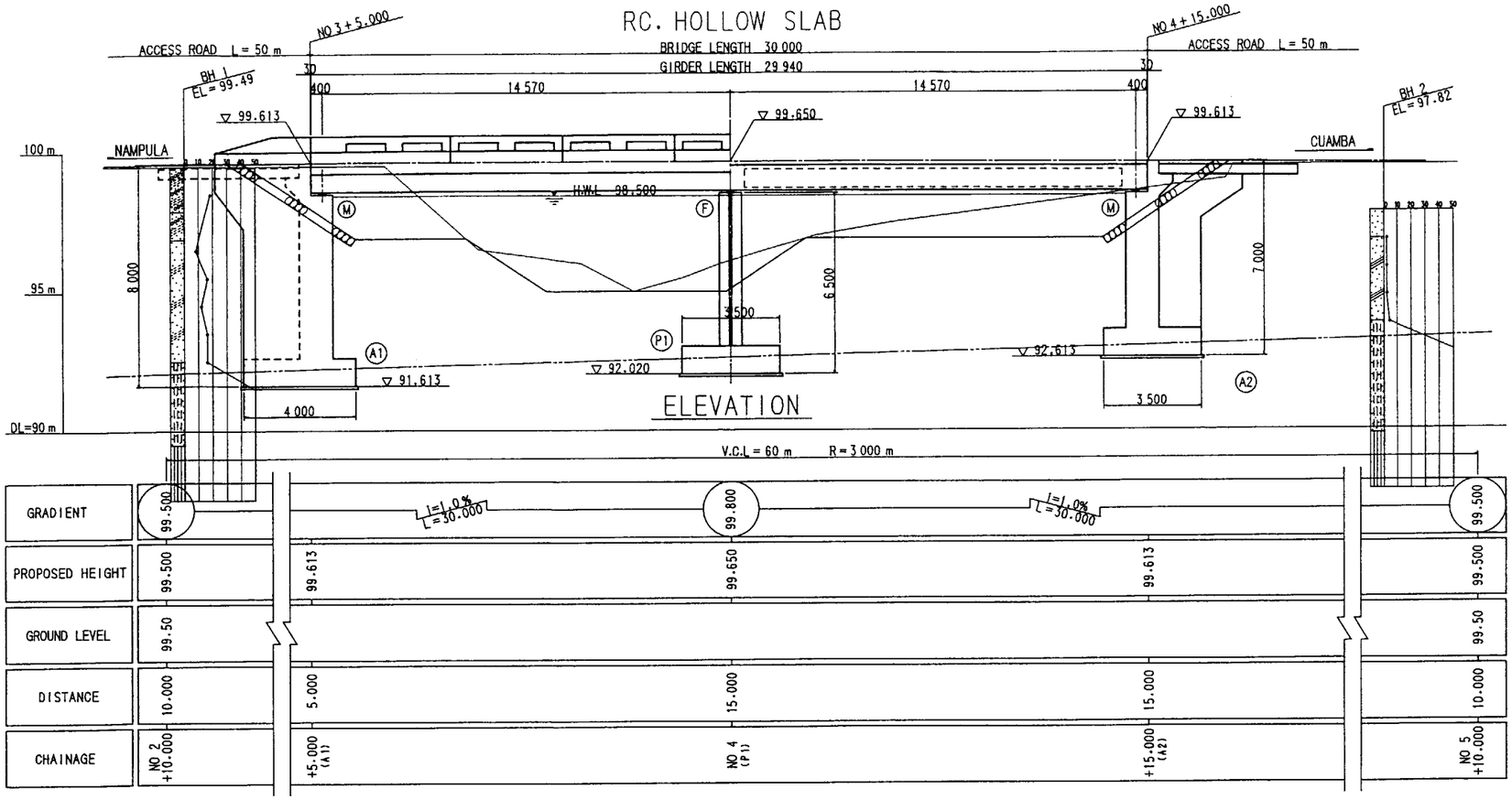
Table-2-3 Plan of Each Bridge

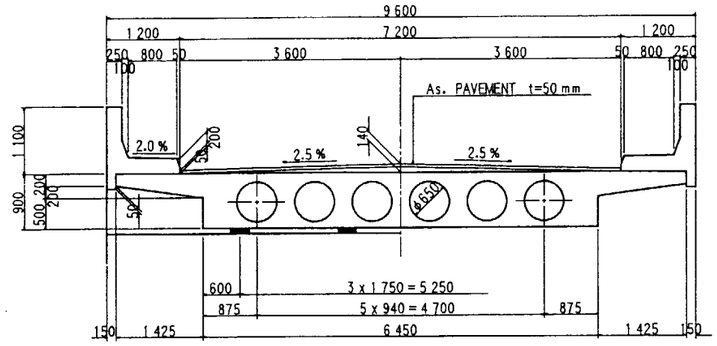
Bridge Name	Bridge Length(m)	Bridge Span(m)	Super-structure	Sub-structure	Foundation	Access Road (m)
Natete	30	14.57+ 14.57	2 span continuous RC Hollow Slab	Negative T Abutment Wall type Pier	Direct Foundation	50+50 =100
Niose	22.9	7.4+7.5 +7.4	–	Repair Abutment	Direct Foundation	50+50 =100
Murusso	21	10.12+ 10.12	2 span continuous RC Hollow Slab	Negative T Abutment Wall type Pier	Direct Foundation	50+50 =100
Namutimbua	30	14.57+ 14.57	2 span continuous RC Hollow Slab	Negative T Abutment Wall type Pier	Pile Foundation	50+50 =100
Ningare	21	10.12+ 10.12	2 span continuous RC Hollow Slab	Negative T Abutment Wall type Pier	Direct Foundation	50+50 =100
Nicaca	21	10.12+ 10.12	2 span continuous RC Hollow Slab	Negative T Abutment Wall type Pier	Direct Foundation	90+60 =150
Namilate	10	9.24	Simple Beam RC Hollow Slab	Repair Parapet Wall	–	10+10 =20
Marata	10	9.24	Simple Beam RC Hollow Slab	Repair Parapet Wall	–	10+10 =20
Bilila	10	9.24	Simple Beam RC Hollow Slab	Negative T Abutment	Pile Foundation	50+50 =100
Munhonha	10	9.24	Simple Beam RC Hollow Slab	Negative T Abutment	Pile FCundation	50+50 =100
Chinamaze	10	9.24	Simple Beam RC Hollow Slab	Negative T Abutment	Pile Foundation	50+50 =100
Sinonono	10	9.24	Simple Beam RC Hollow Slab	Negative T Abutment	Direct Foundation	50+50 =100
Namihungo	10	9.24	Simple Beam RC Hollow Slab	Negative T Abutment	Direct Foundation	50+50 =100
Sambalendo	11	10.24	Simple Beam RC Hollow Slab	Repair Parapet Wall	–	50+65 =115
Xisadze II	20.6	19.88	Simple Beam PC Hollow Slab	Repair Parapet Wall	–	50+50 =100

(2) Basic Design Drawing

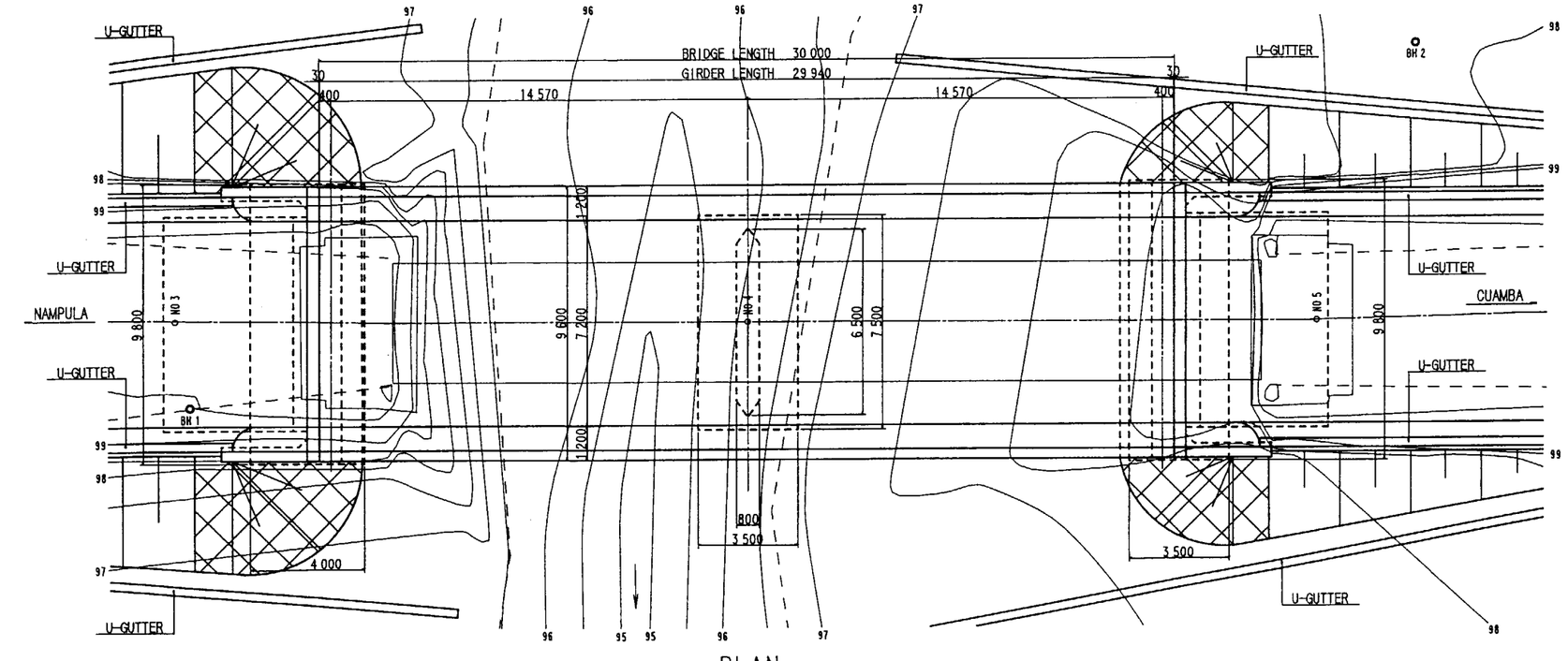
Basic Design Drawing for the bridges are as shown in Fig-2-4~Fig-2-33.

NATETE BRIDGE GENERAL ARRANGEMENT S = 1 : 100





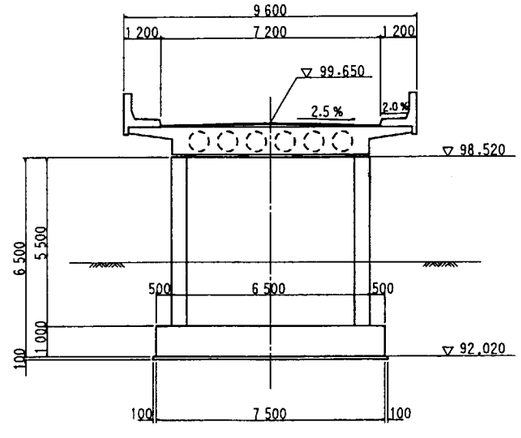
CROSS SECTION S = 1 : 50



PLAN

ABUTMENT
A1 (A2)

PIER
P1

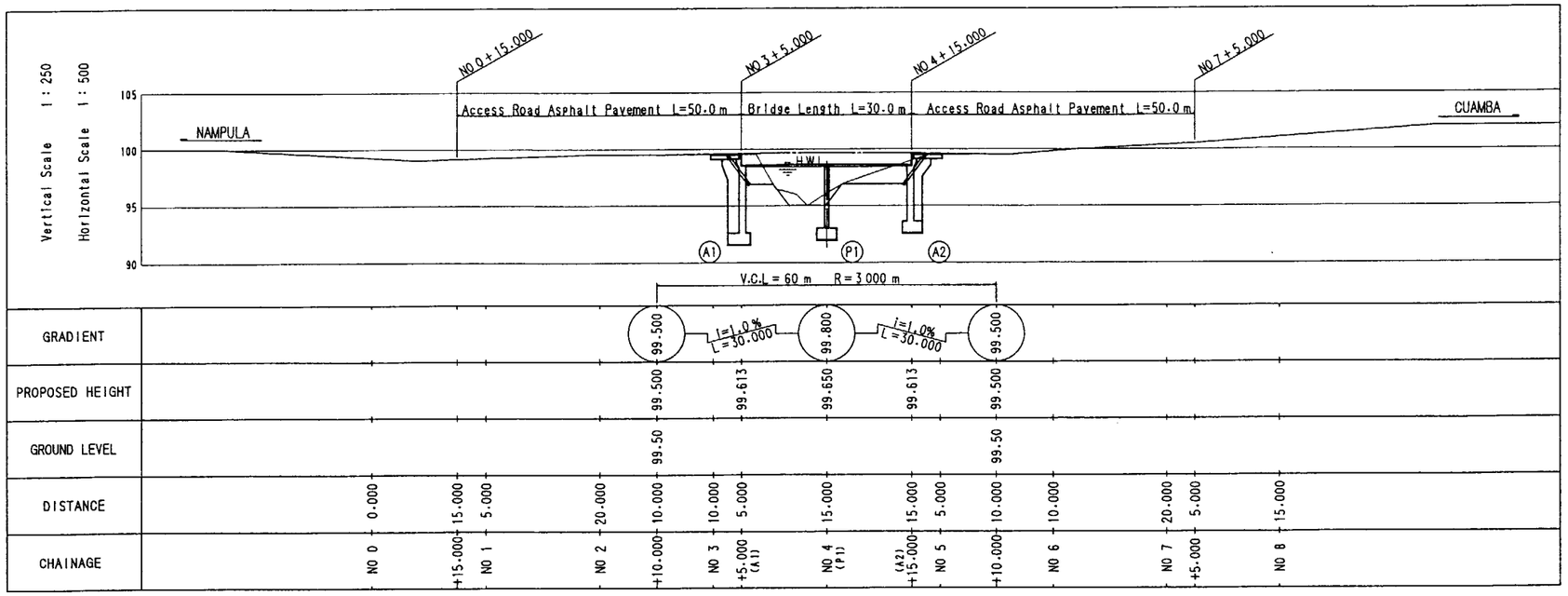


FRONT VIEW

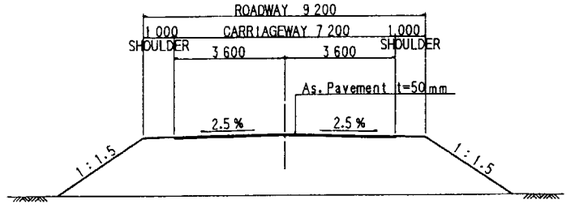
Fig-2-4 Natete Bridge

PLAN OF ACCESS ROAD

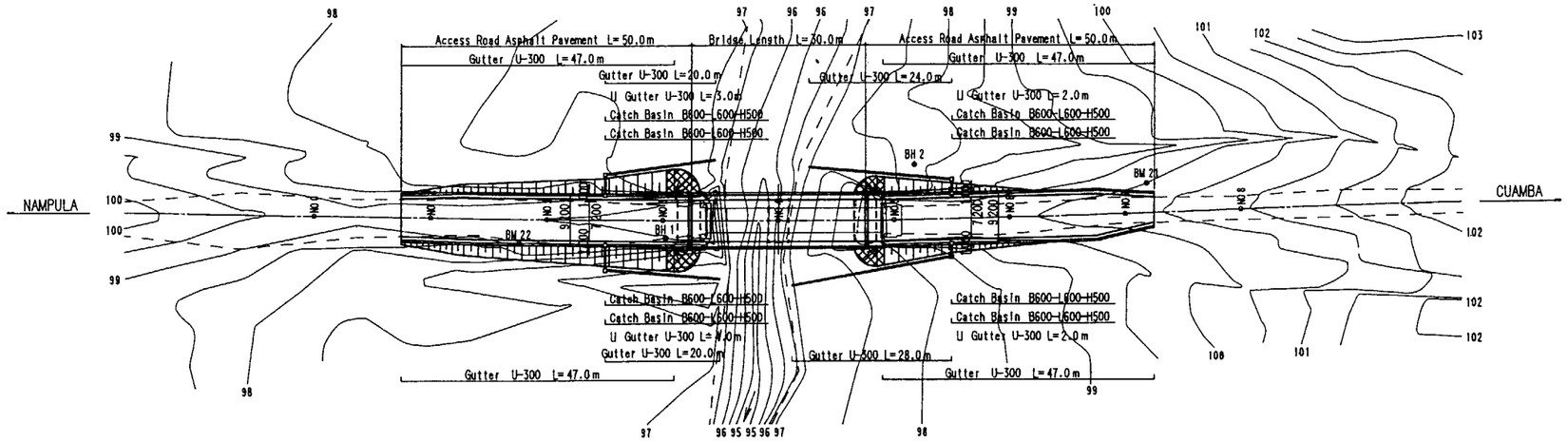
NATETE BRIDGE



PROFILE



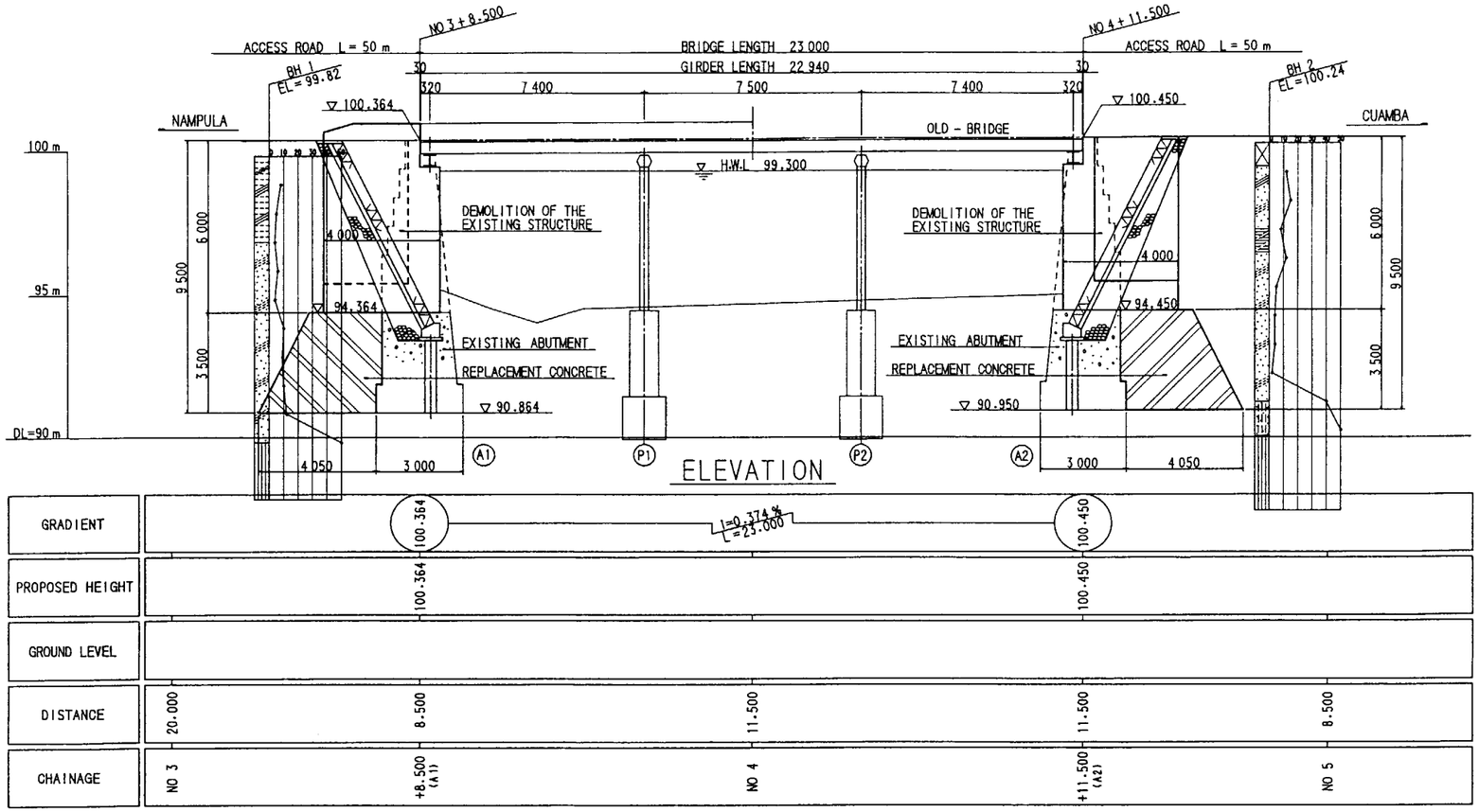
TYPICAL CROSS SECTION S = 1 : 100

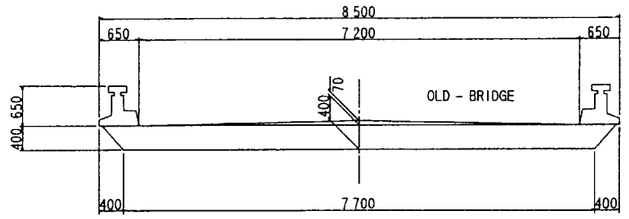


PLAN S = 1 : 500

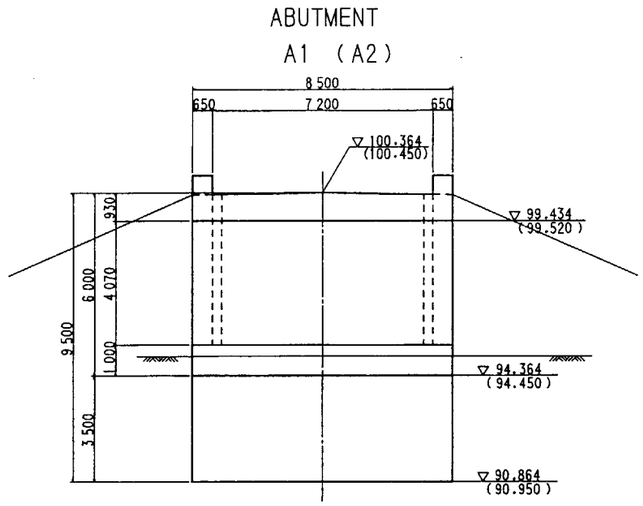
Fig-2-5 Natete Bridge Access Road

NIOSE BRIDGE GENERAL ARRANGEMENT S=1:100

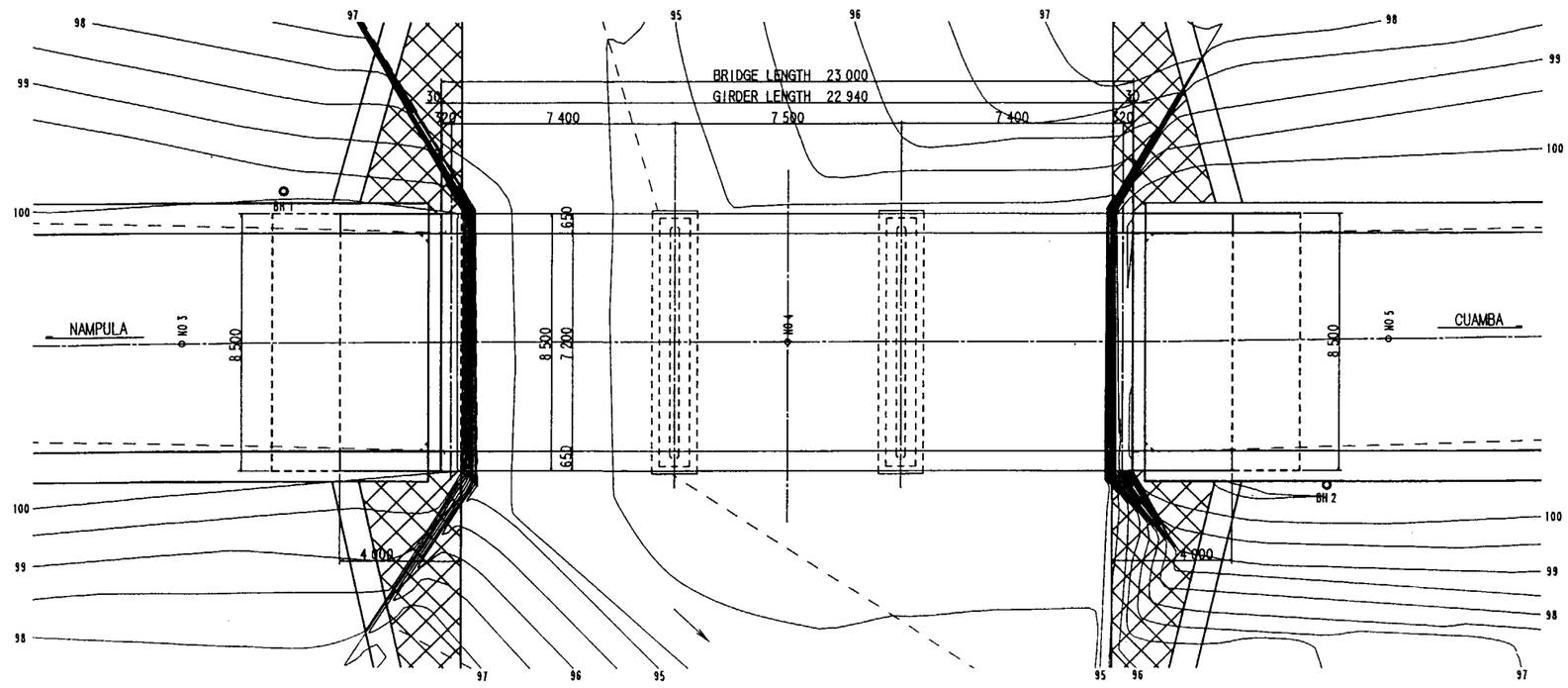




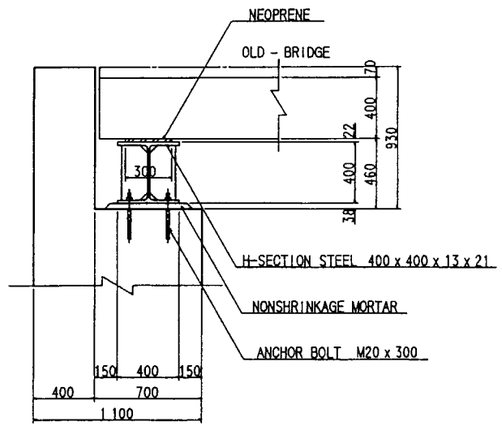
CROSS SECTION S=1:50



FRONT VIEW



PLAN

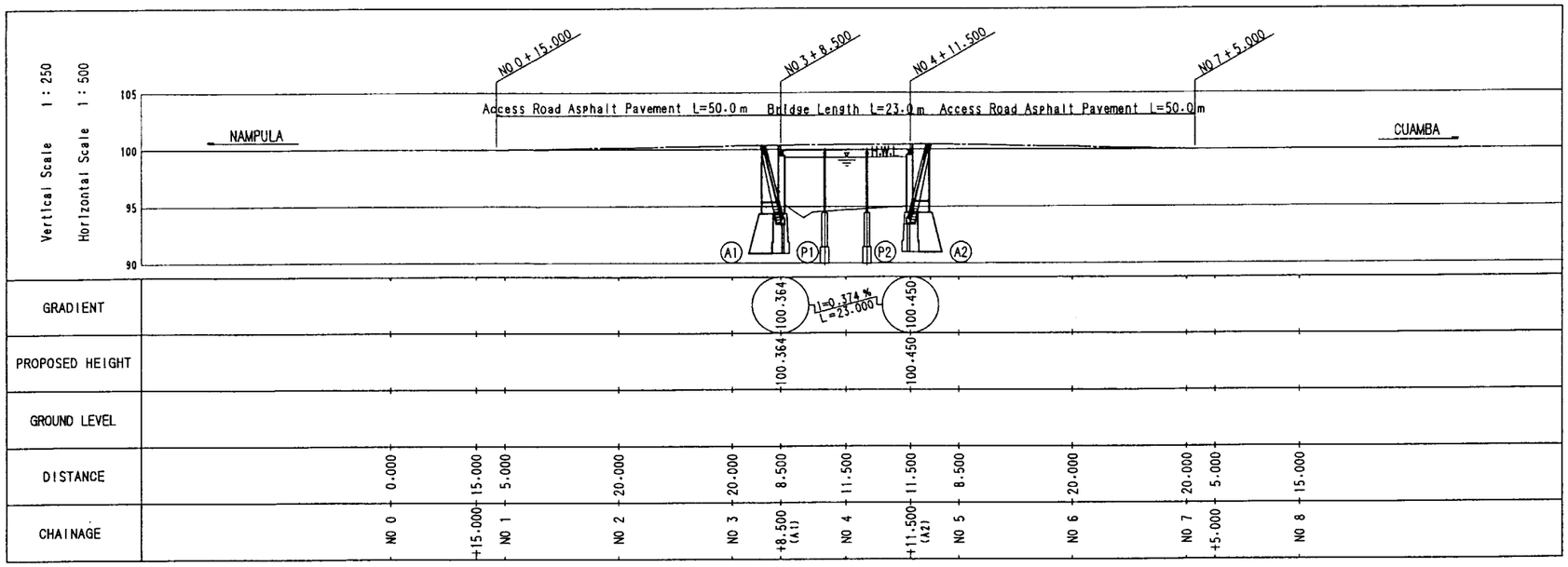


BRIDGE SEAT S=1:20

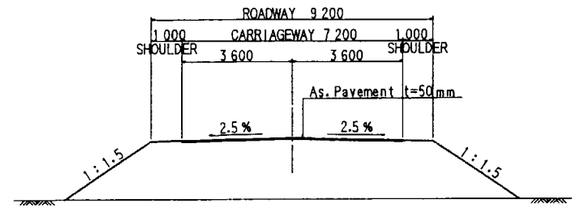
Fig-2-6 Nioce Bridge

PLAN OF ACCESS ROAD

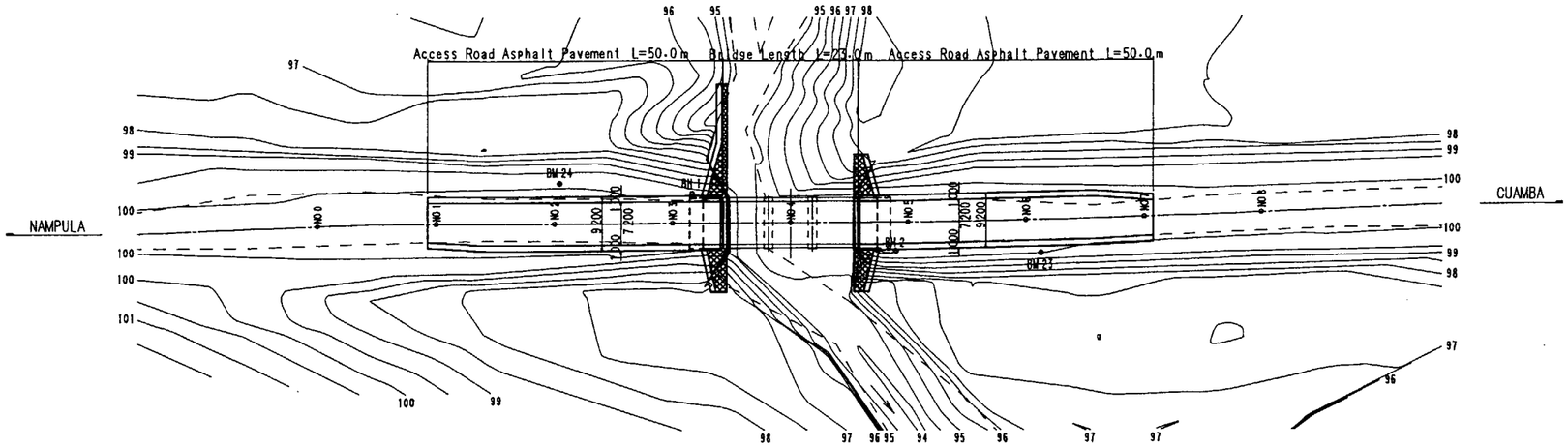
NIOSE BRIDGE



PROFILE



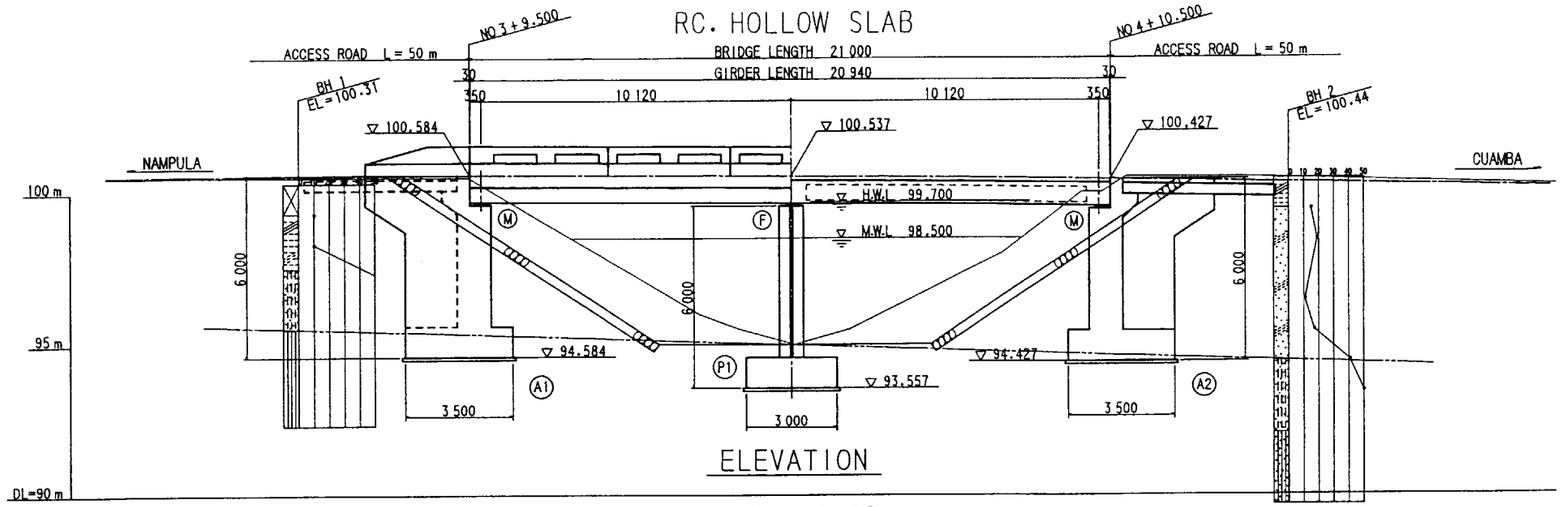
TYPICAL CROSS SECTION S = 1 : 100



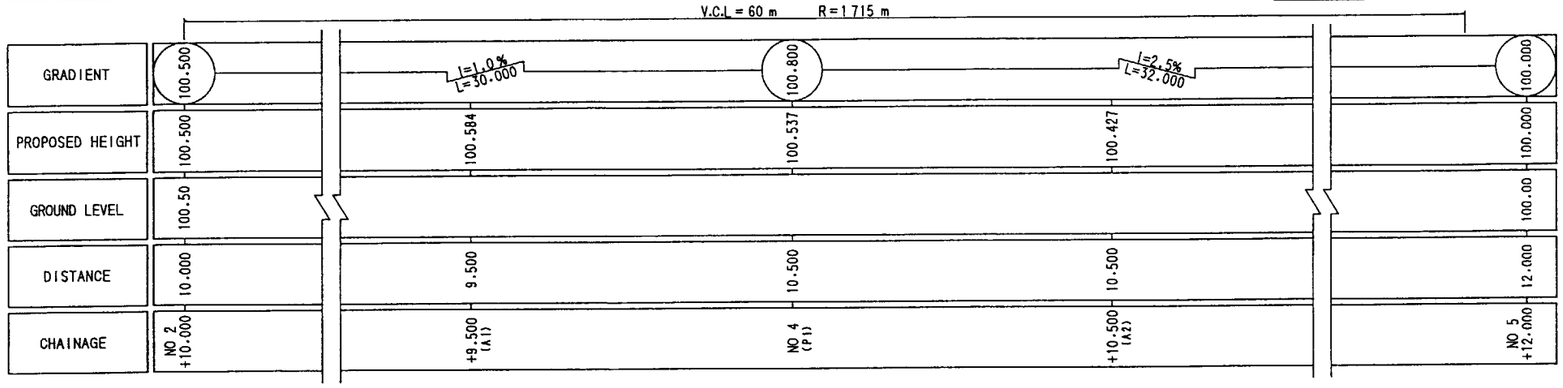
PLAN S = 1 : 500

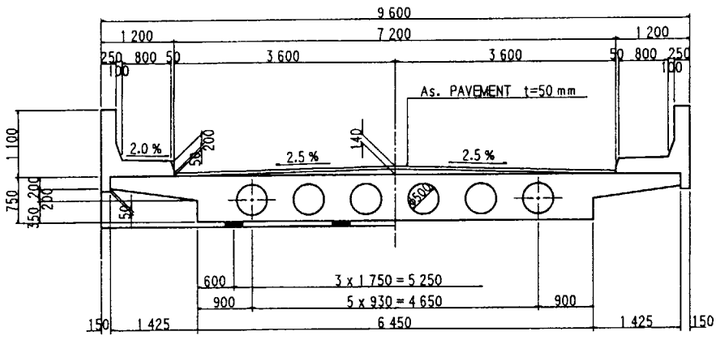
Fig-2-7 Nioce Bridge Access Road

MURUSSO BRIDGE GENERAL ARRANGEMENT S=1:100



ELEVATION

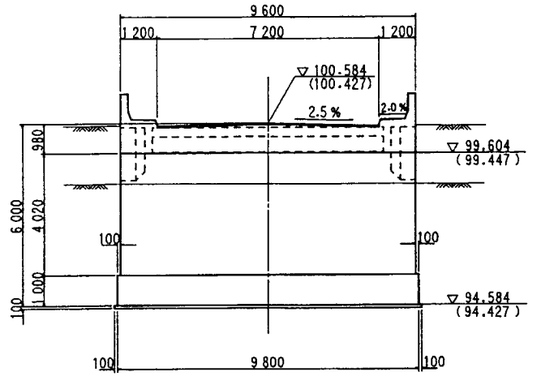




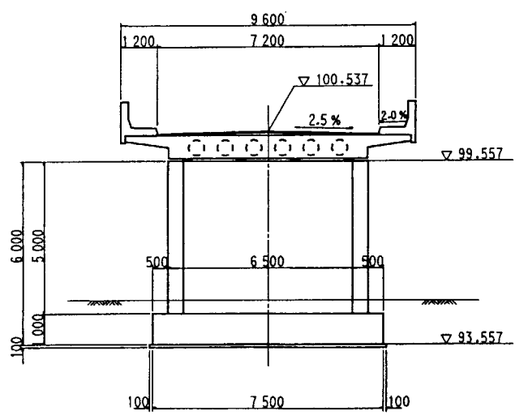
CROSS SECTION S=1:50

PLAN

ABUTMENT
A1 (A2)



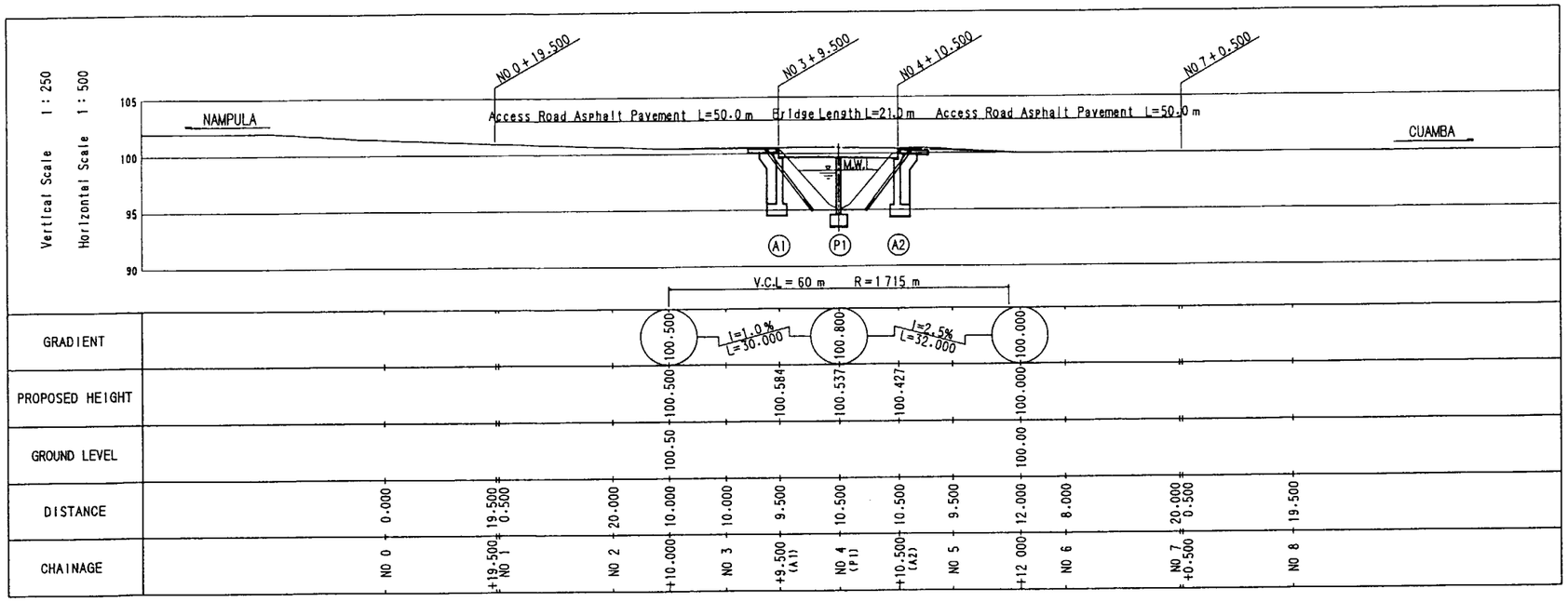
PIER
P1



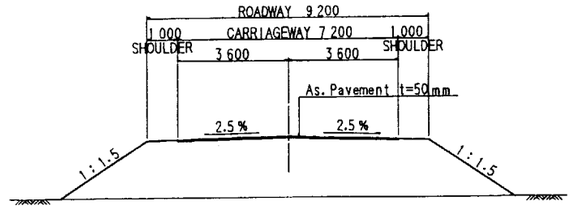
FRONT VIEW

Fig-2-8 Murusso Bridge

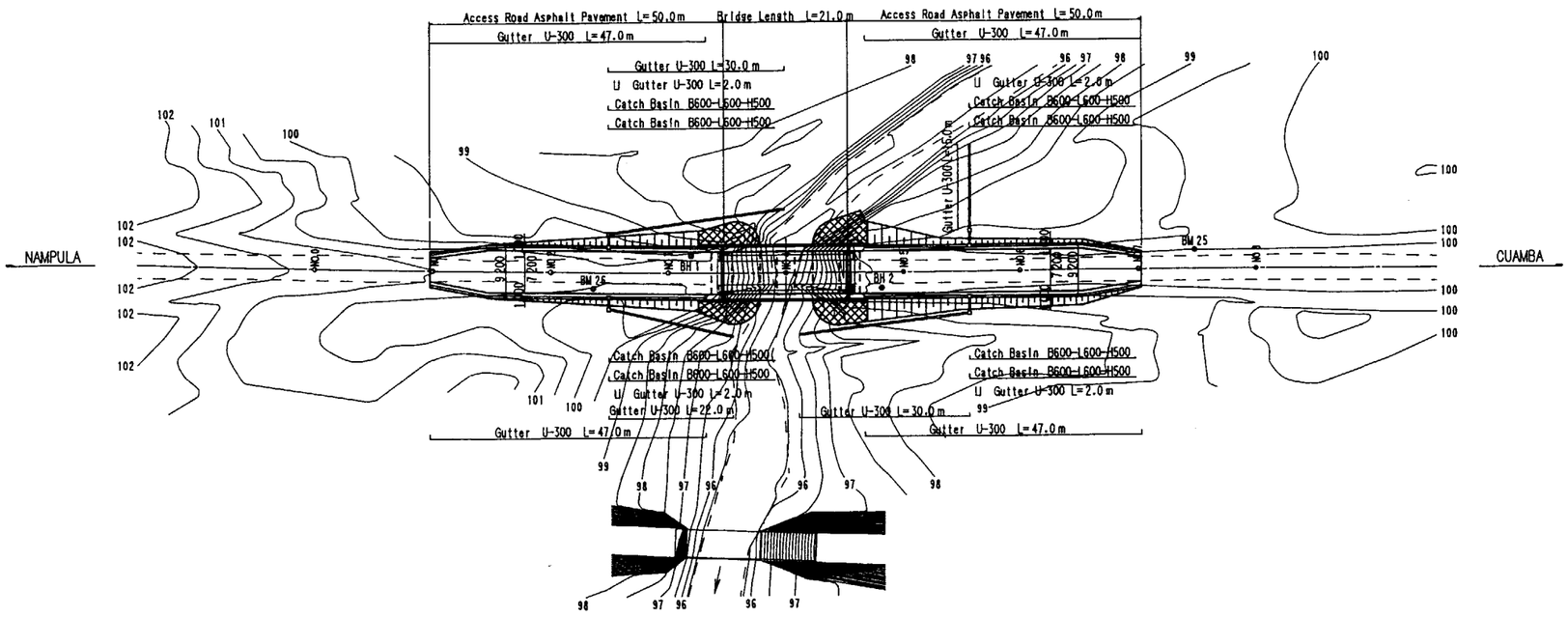
PLAN OF ACCESS ROAD MURUSSO BRIDGE



PROFILE



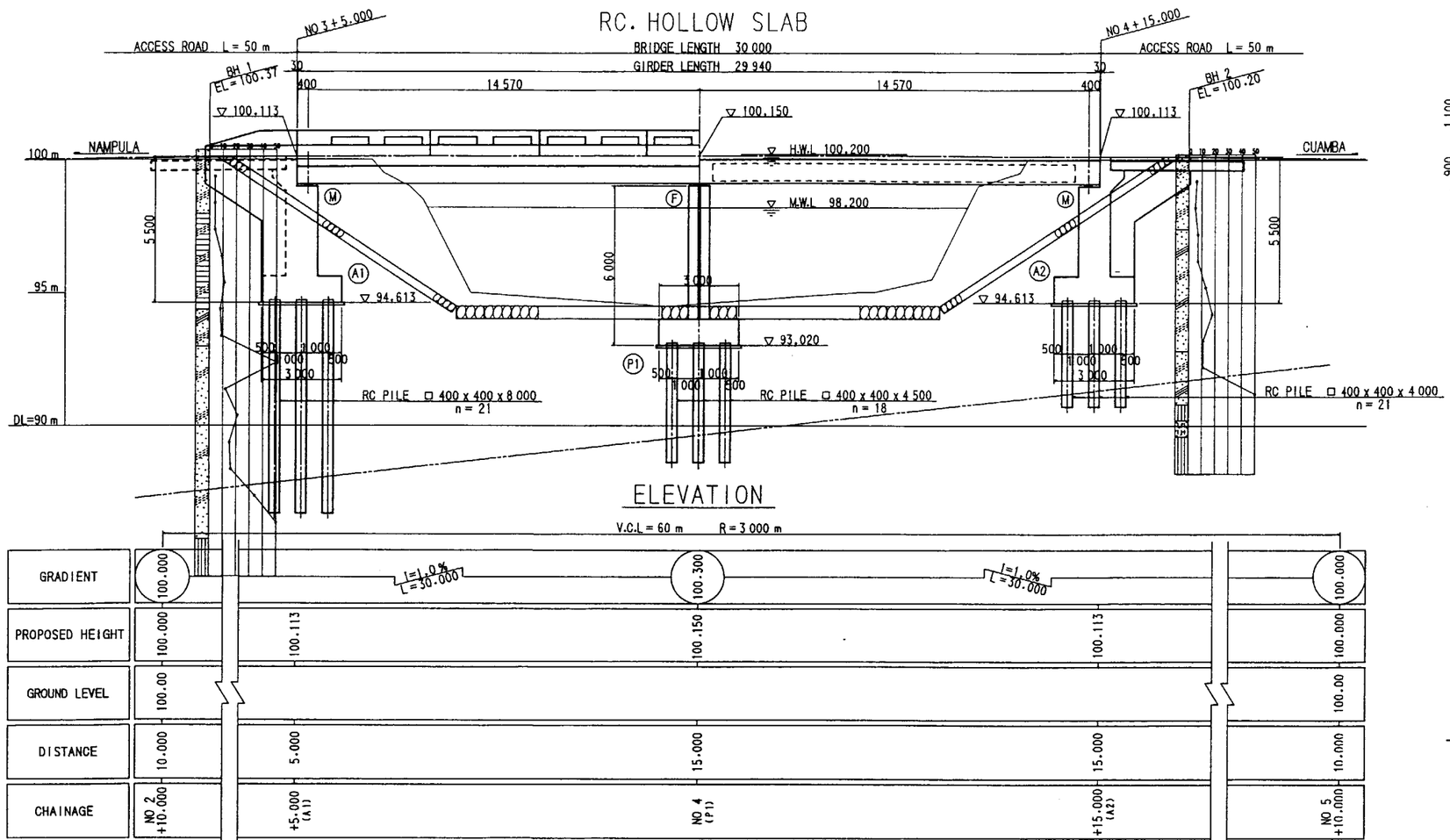
TYPICAL CROSS SECTION S=1:100

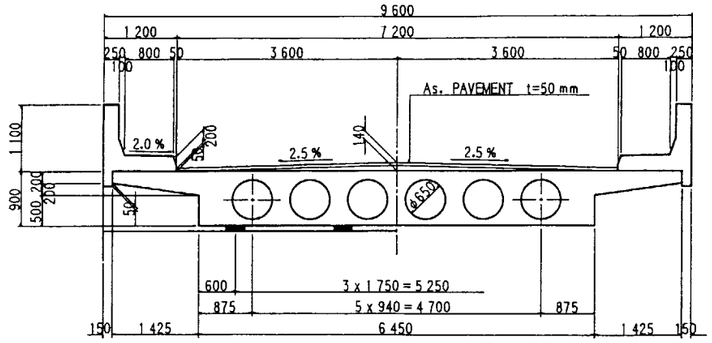


PLAN S=1:500

Fig-2-9 Murusso Bridge Access Road

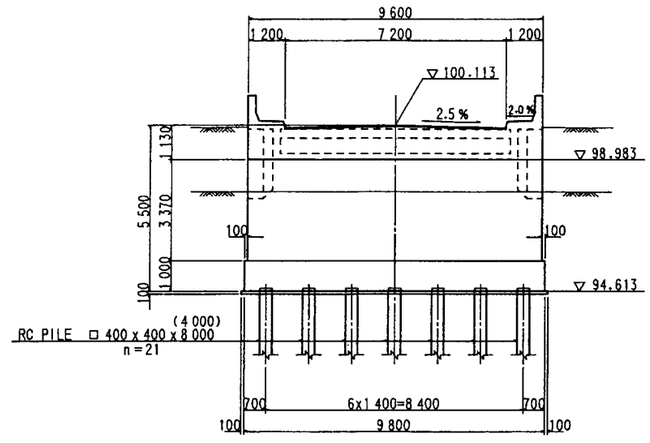
NAMUTIMBUA BRIDGE GENERAL ARRANGEMENT S = 1 : 100



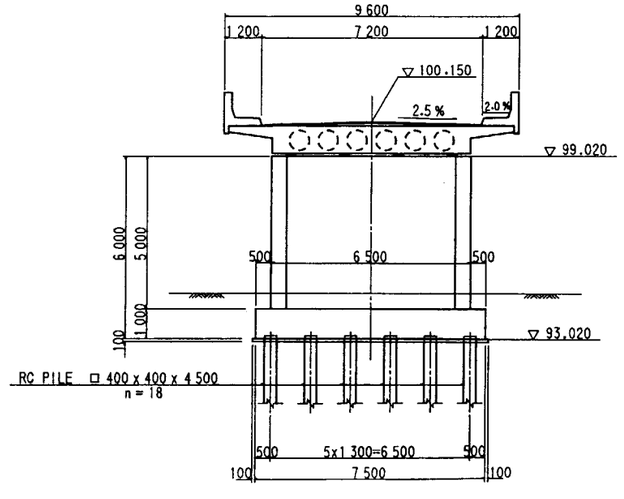


CROSS SECTION S = 1 : 50

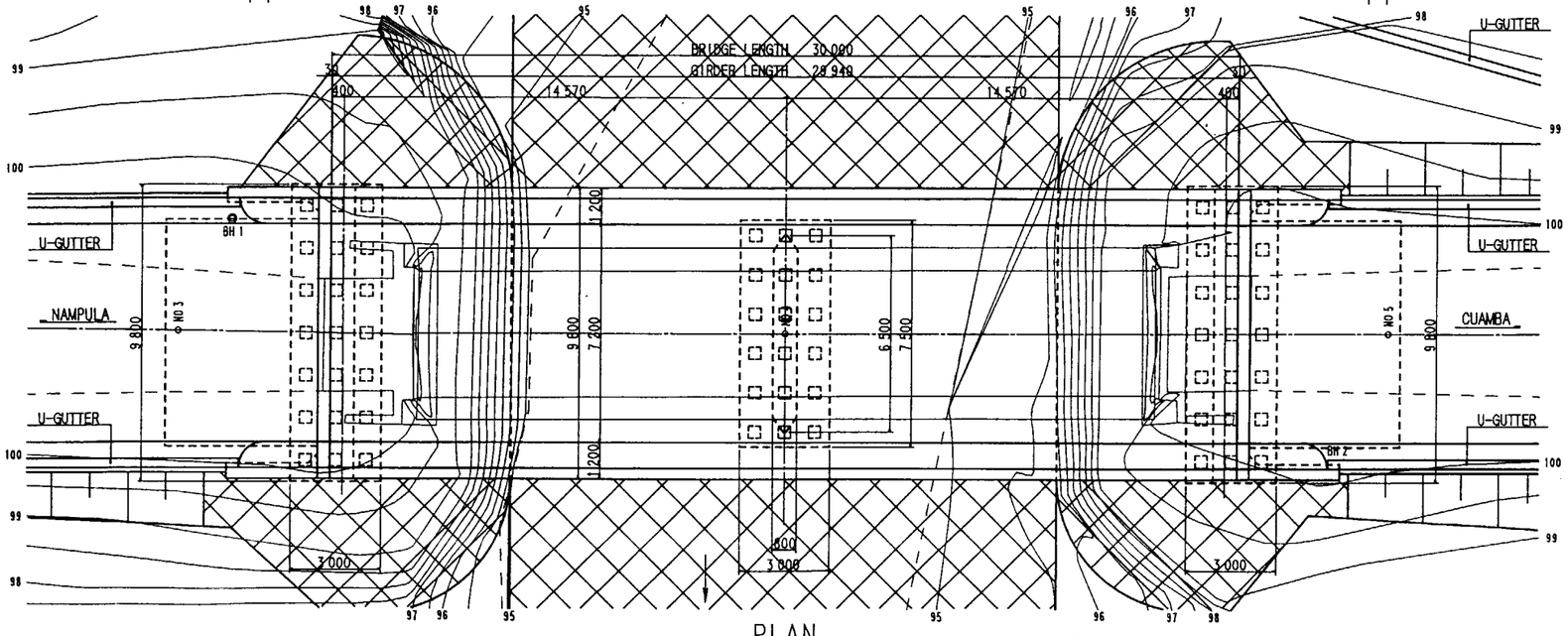
ABUTMENT
A1 (A2)



PIER
P1



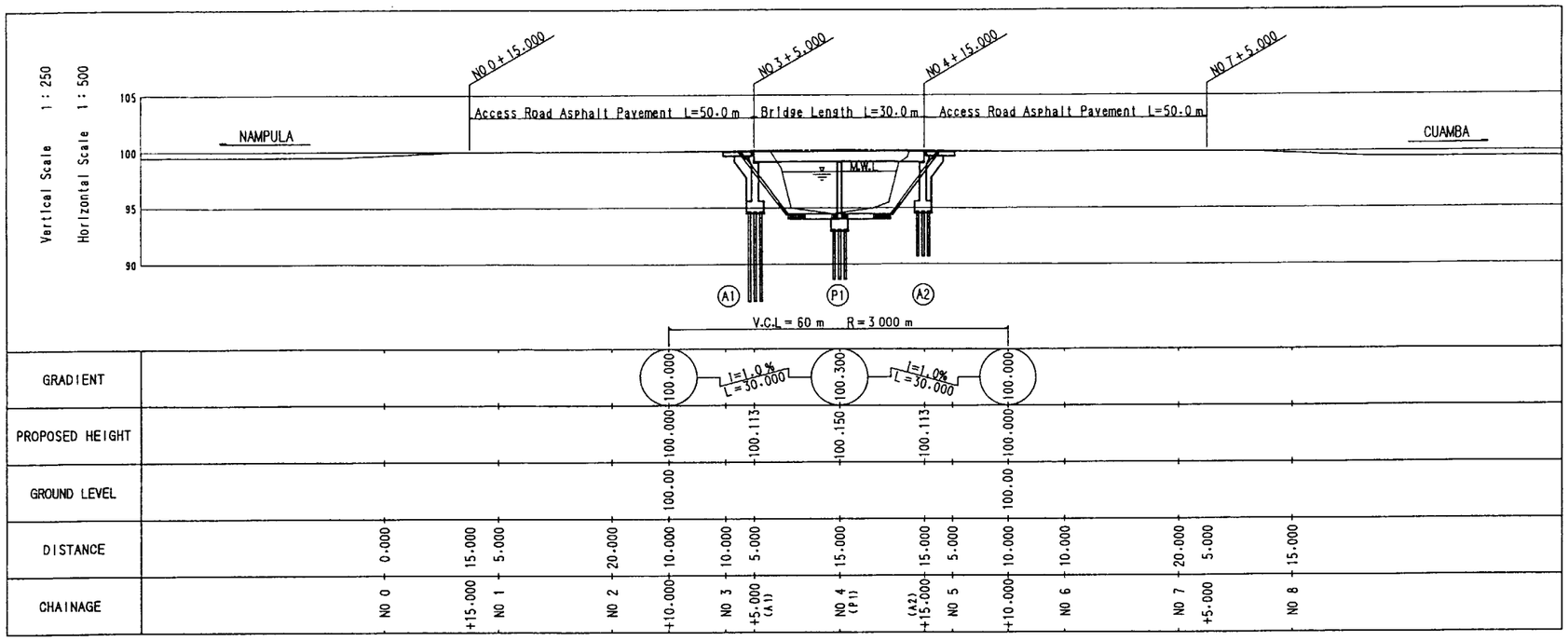
FRONT VIEW



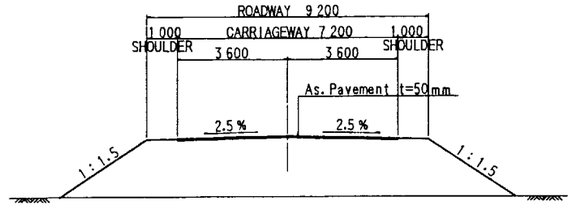
PLAN

Fig-2-10 Namutimbua Bridge

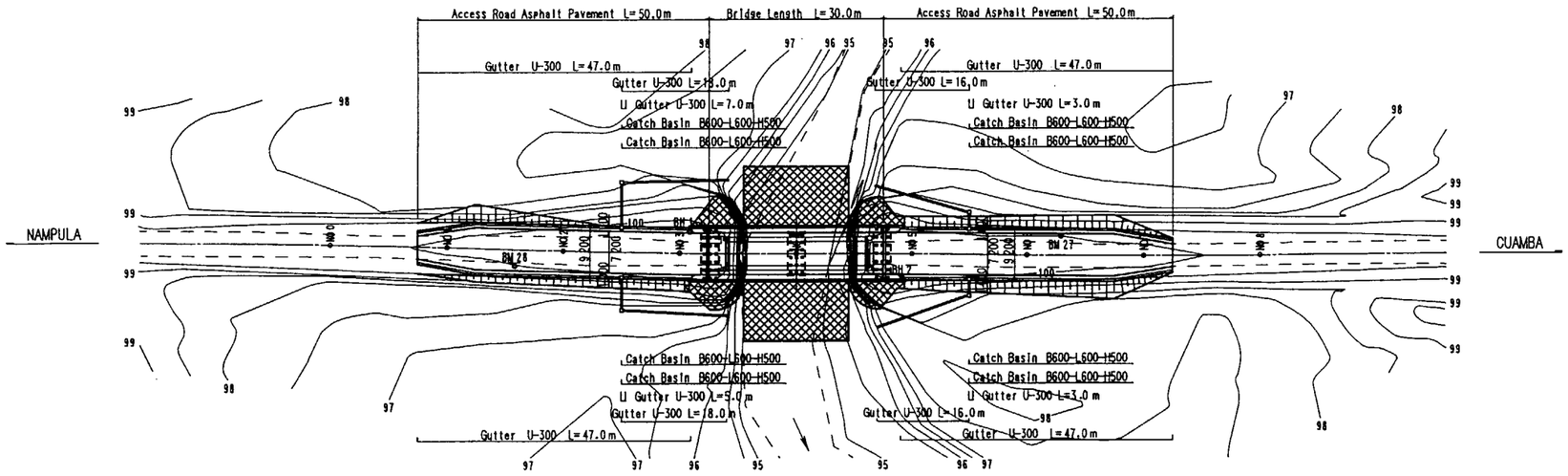
PLAN OF ACCESS ROAD NAMUTIMBUA BRIDGE



PROFILE



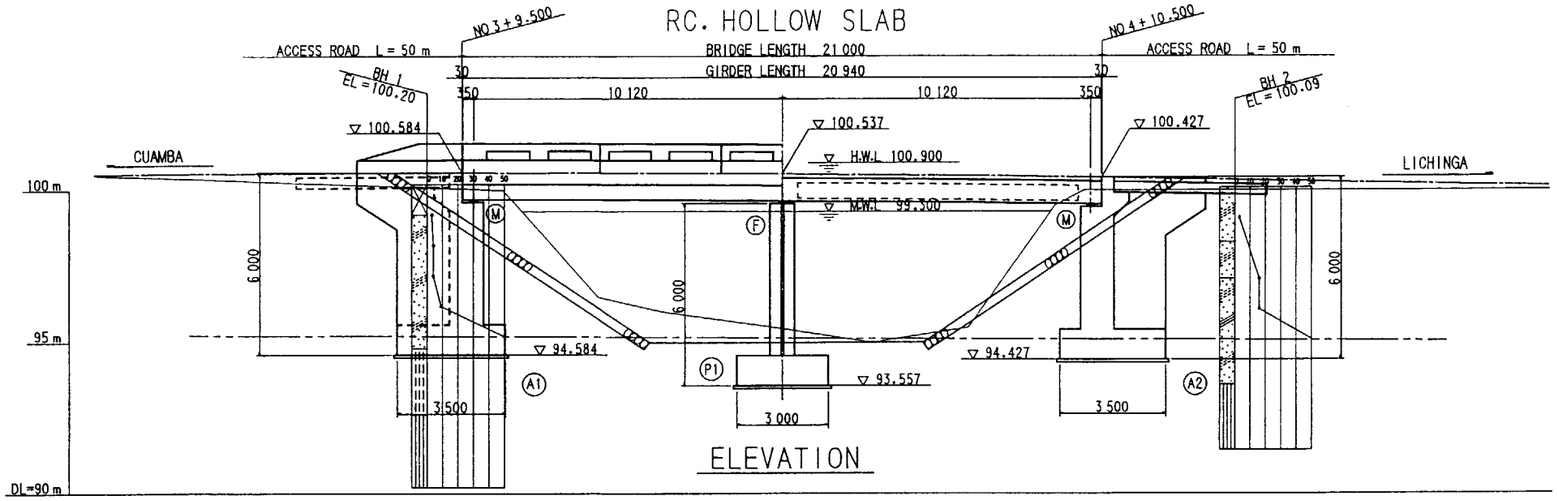
TYPICAL CROSS SECTION S = 1 : 100

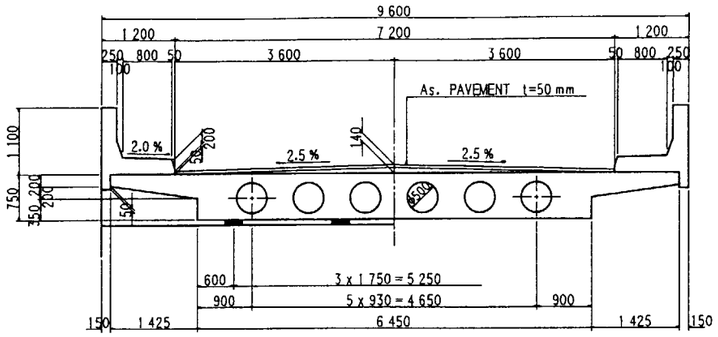


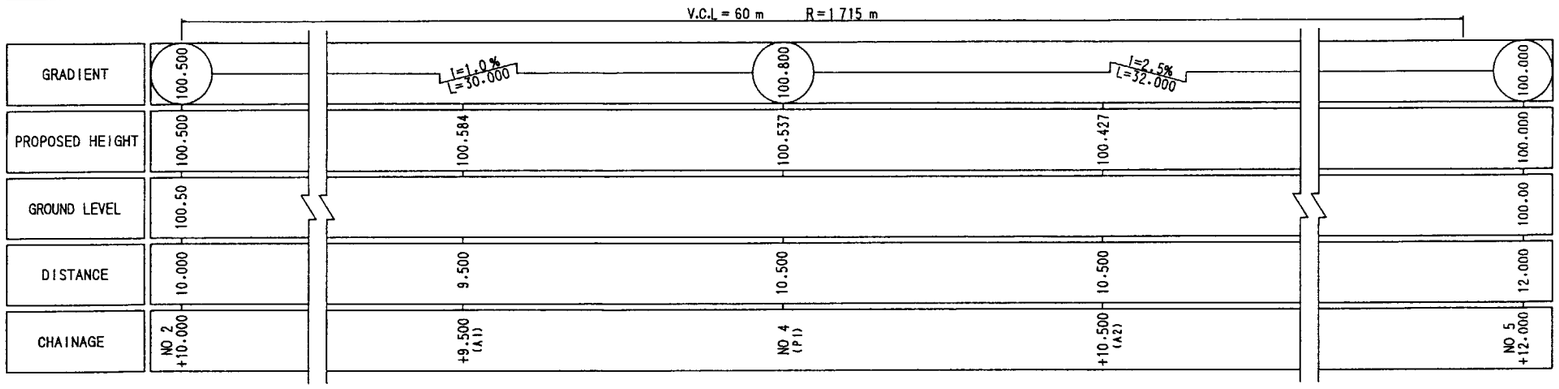
PLAN S = 1 : 500

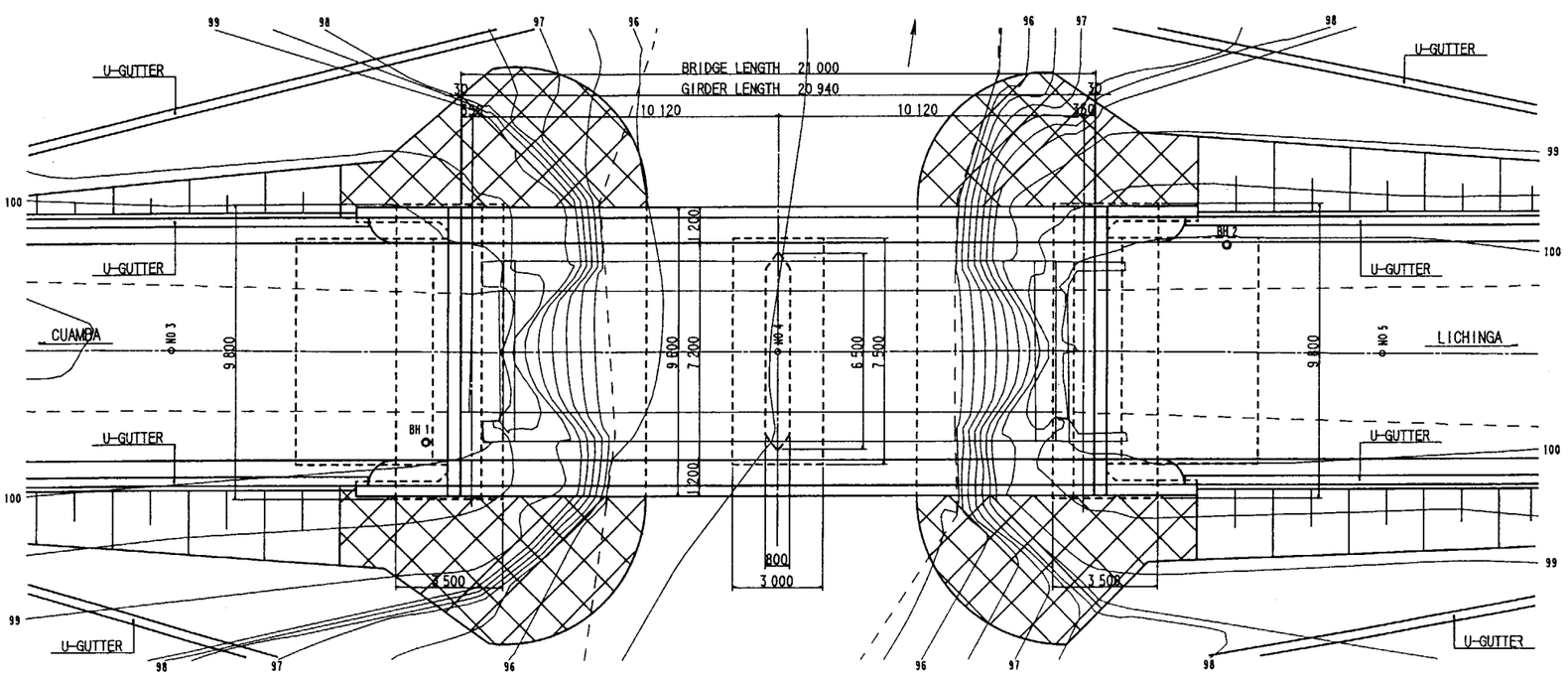
Fig-2-11 Namutimbua Bridge Access Road

NINGARE BRIDGE GENERAL ARRANGEMENT S=1:100

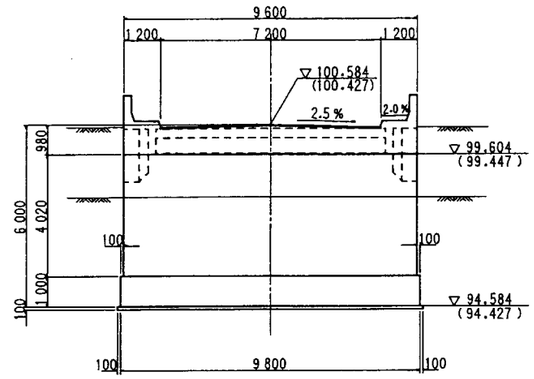








ABUTMENT
A1 (A2)



PIER
P1

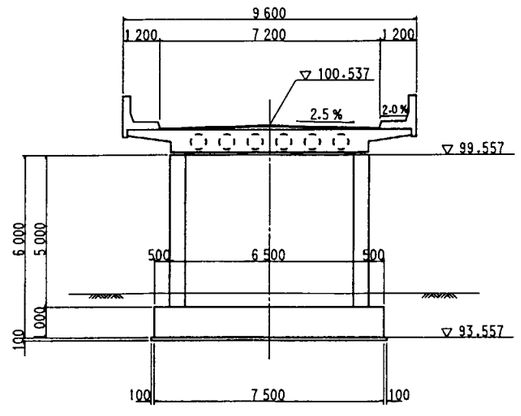
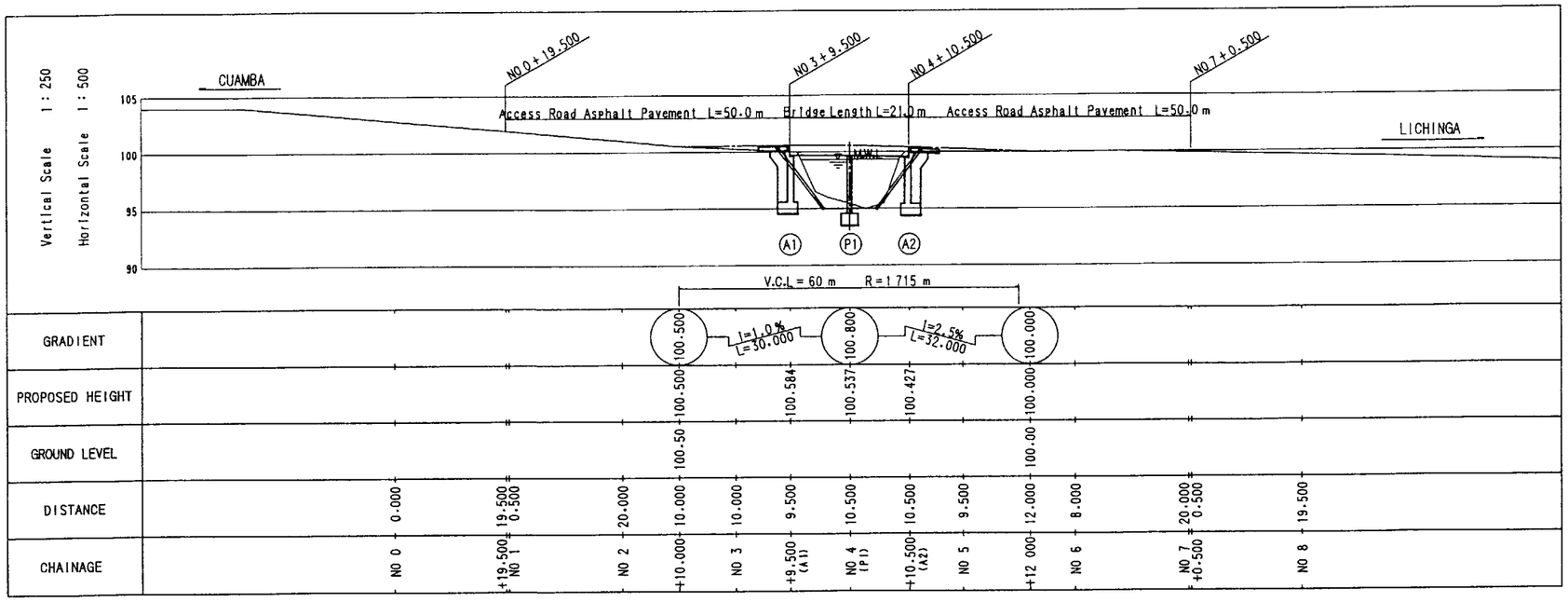
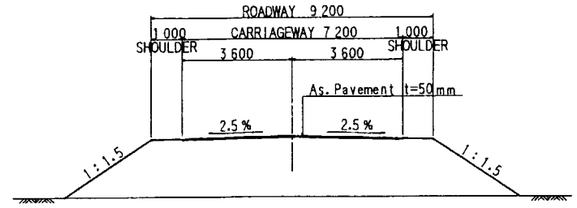


Fig-2-12 Ningare Bridge

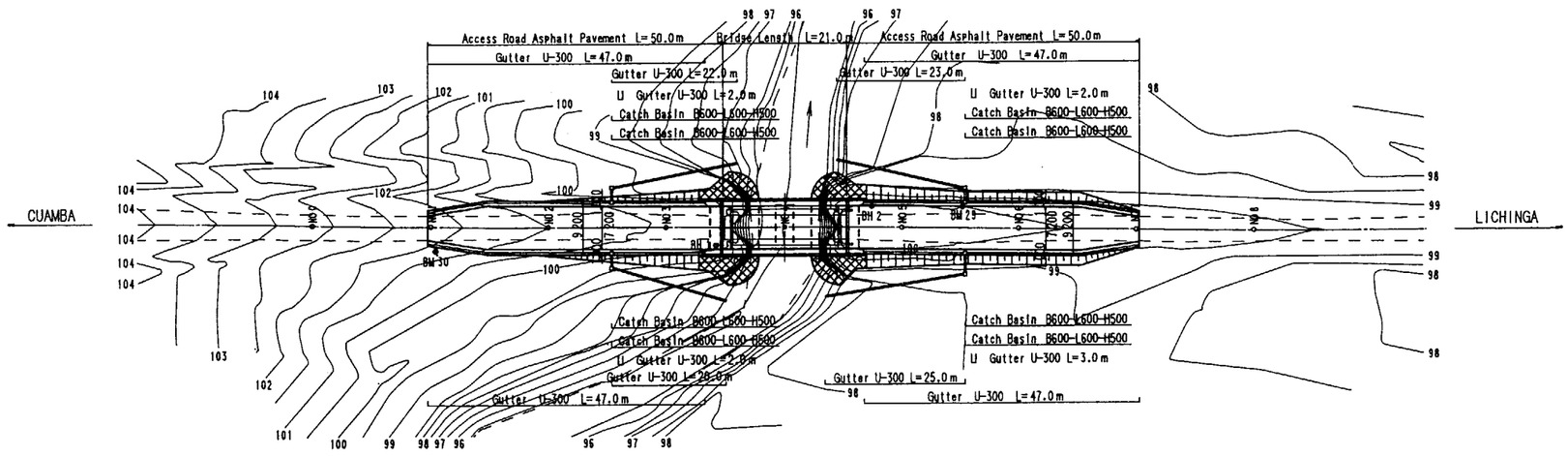
PLAN OF ACCESS ROAD NINGARE BRIDGE



PROFILE



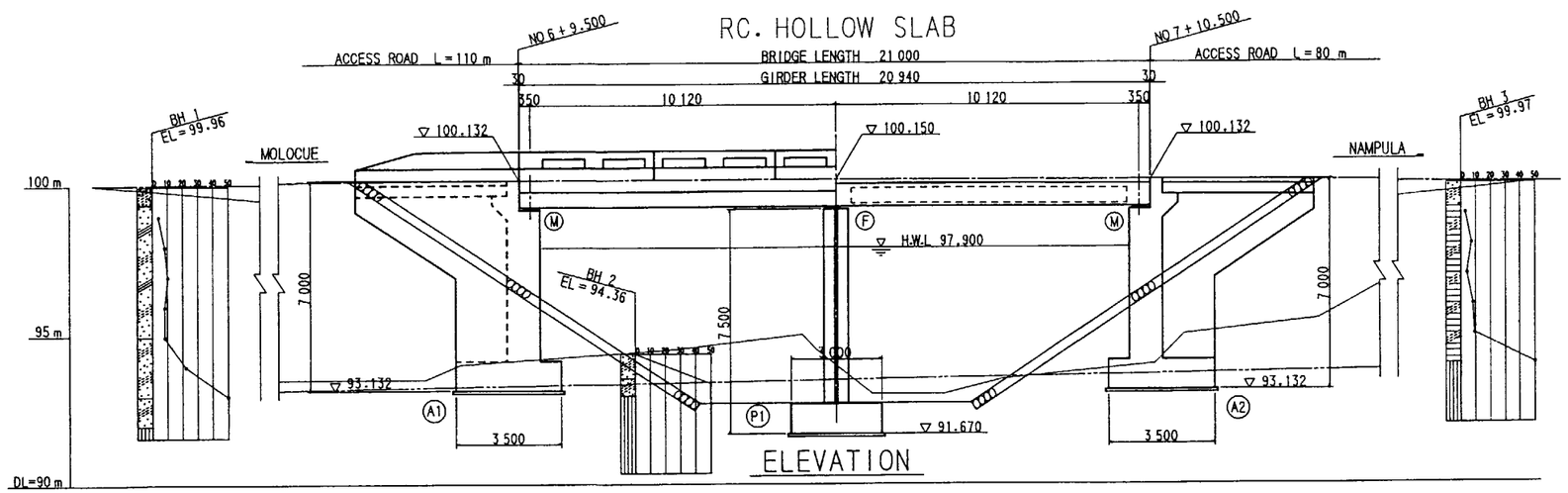
TYPICAL CROSS SECTION S = 1 : 100



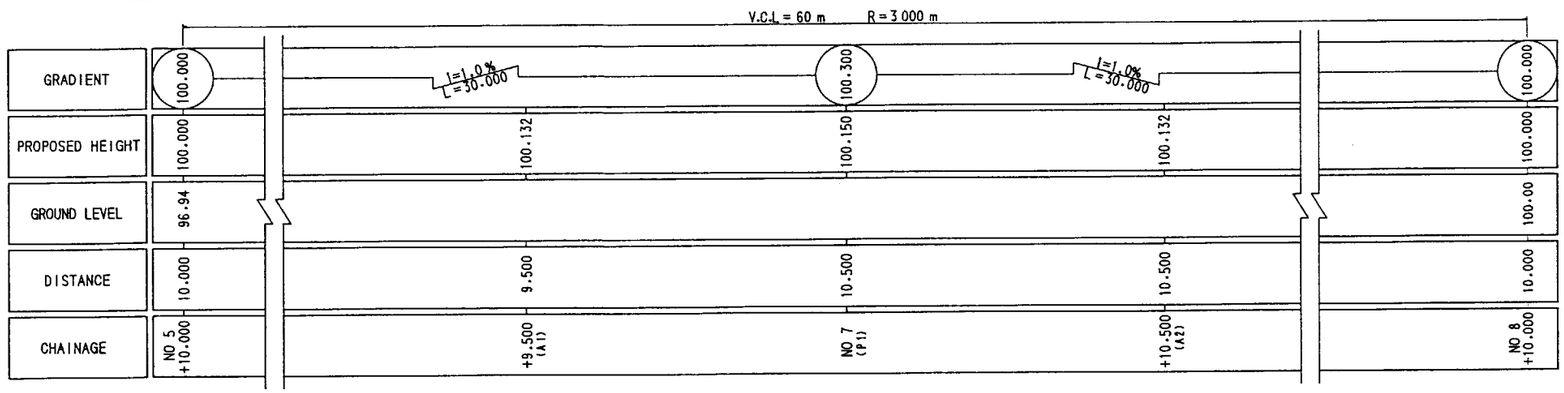
PLAN S = 1 : 500

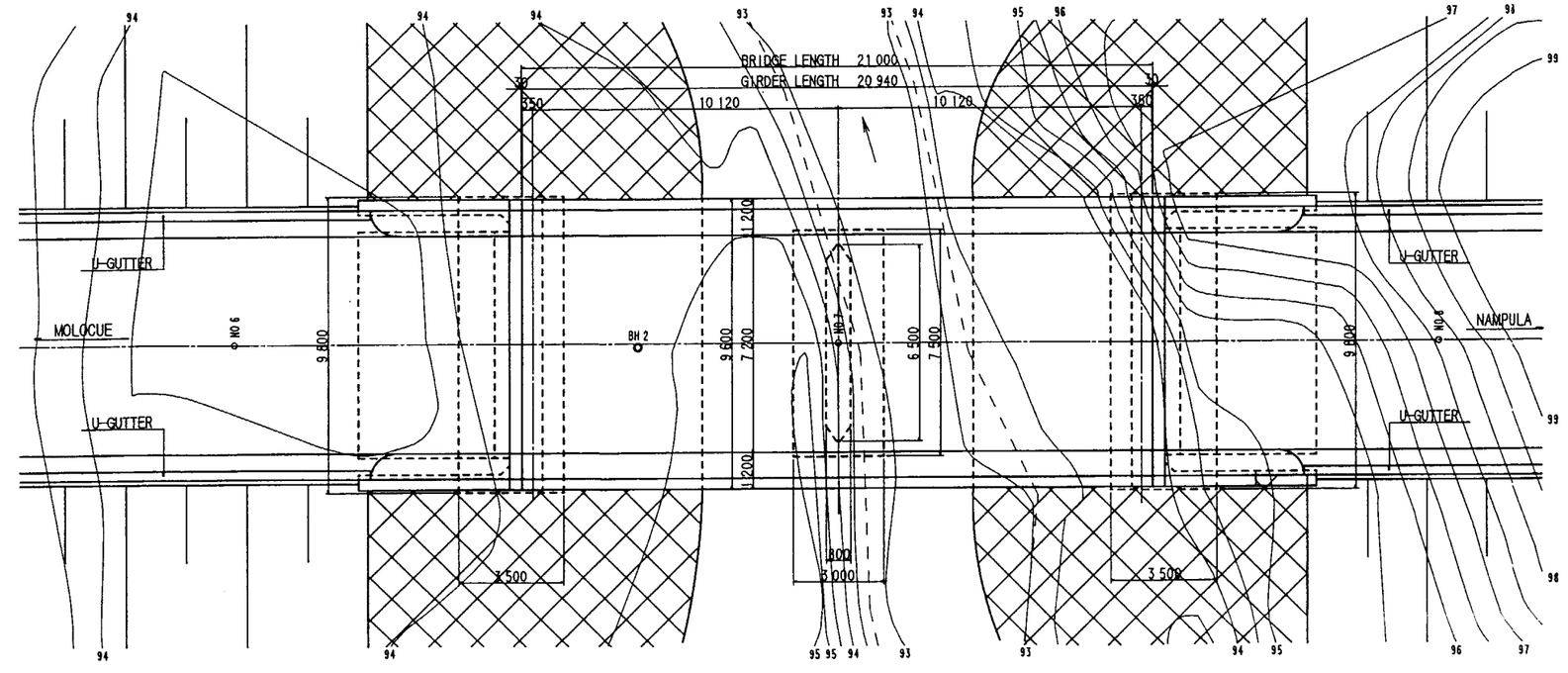
Fig-2-13 Ningare Bridge Access Road

NICACA BRIDGE GENERAL ARRANGEMENT S=1:100

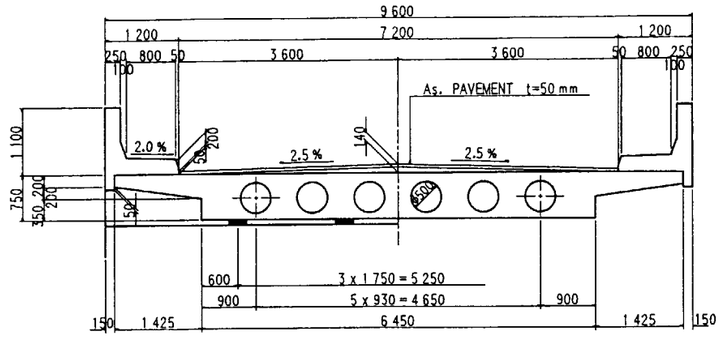


ELEVATION



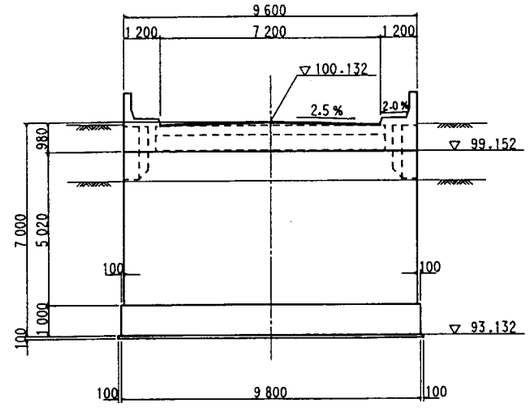


PLAN

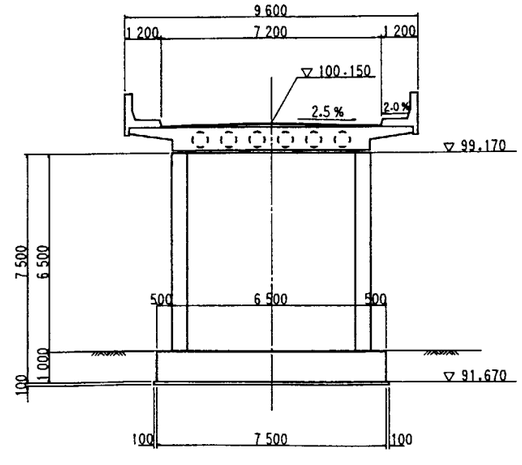


CROSS SECTION S=1:50

ABUTMENT
A1 A2



PIER
P1

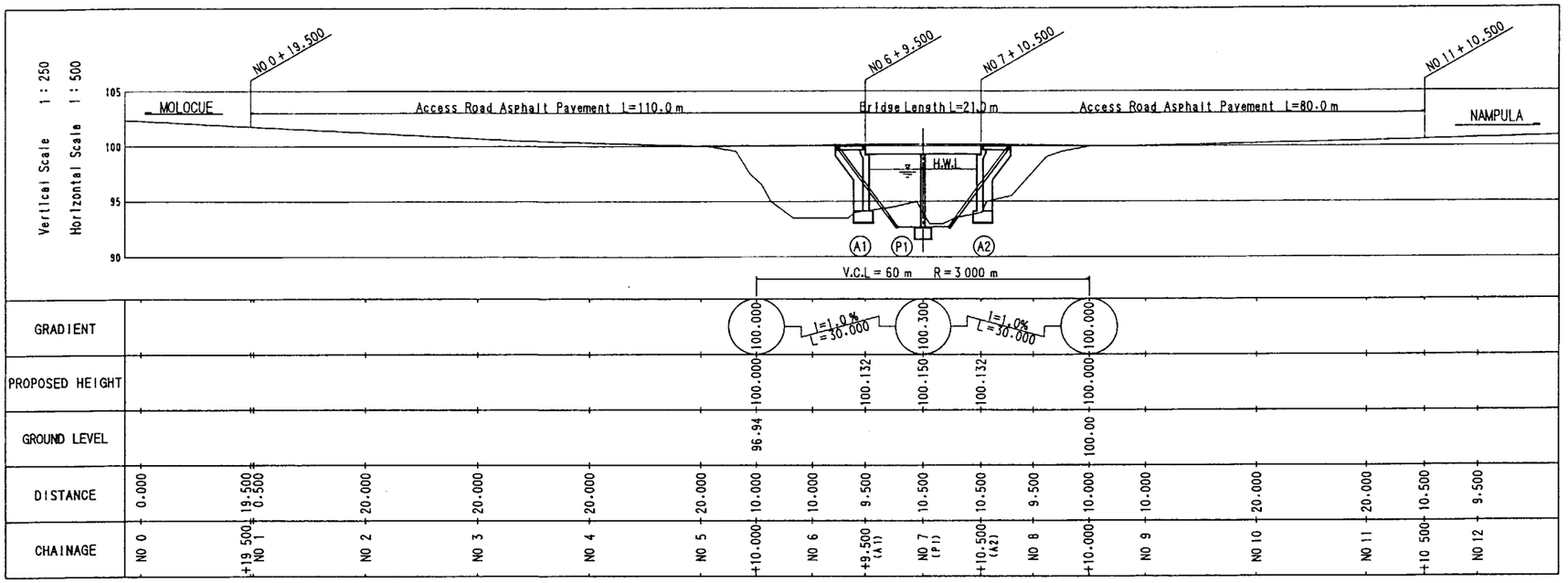


FRONT VIEW

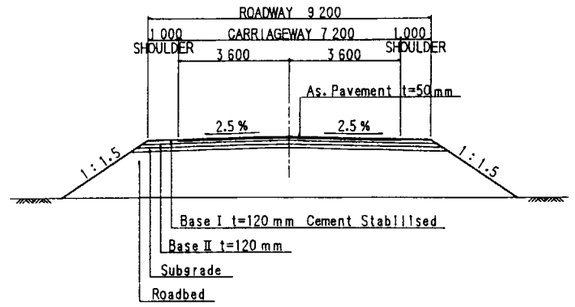
Fig-2-14 Nicaca Bridge

PLAN OF ACCESS ROAD

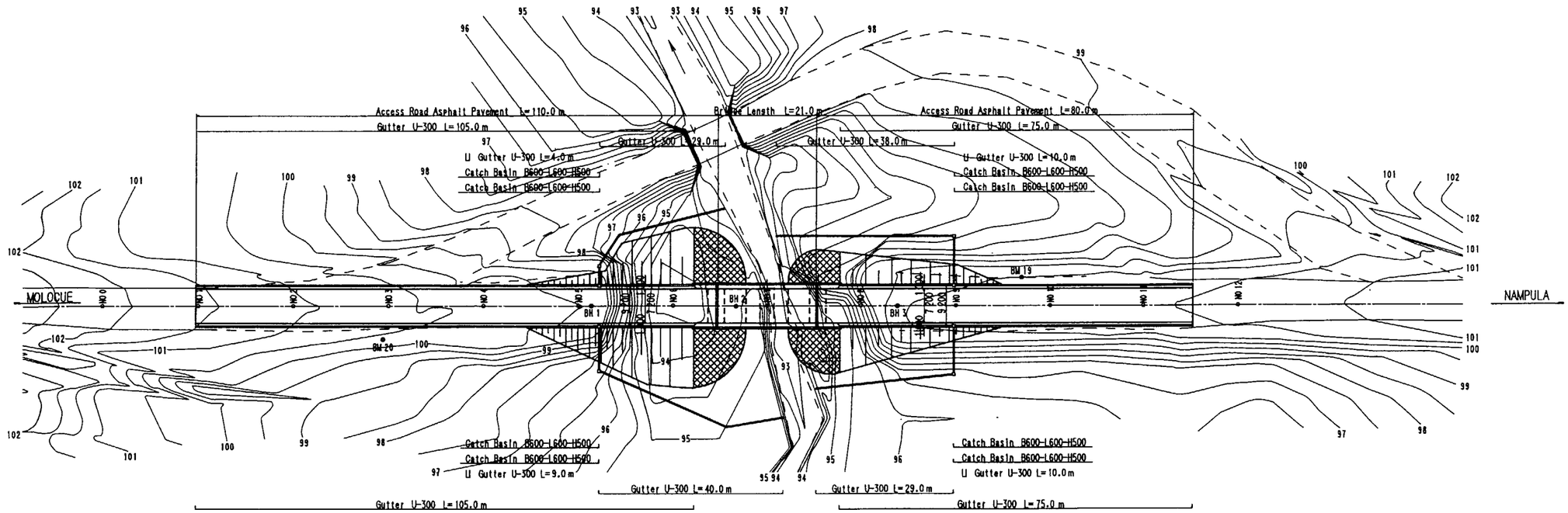
NICACA BRIDGE



PROFILE



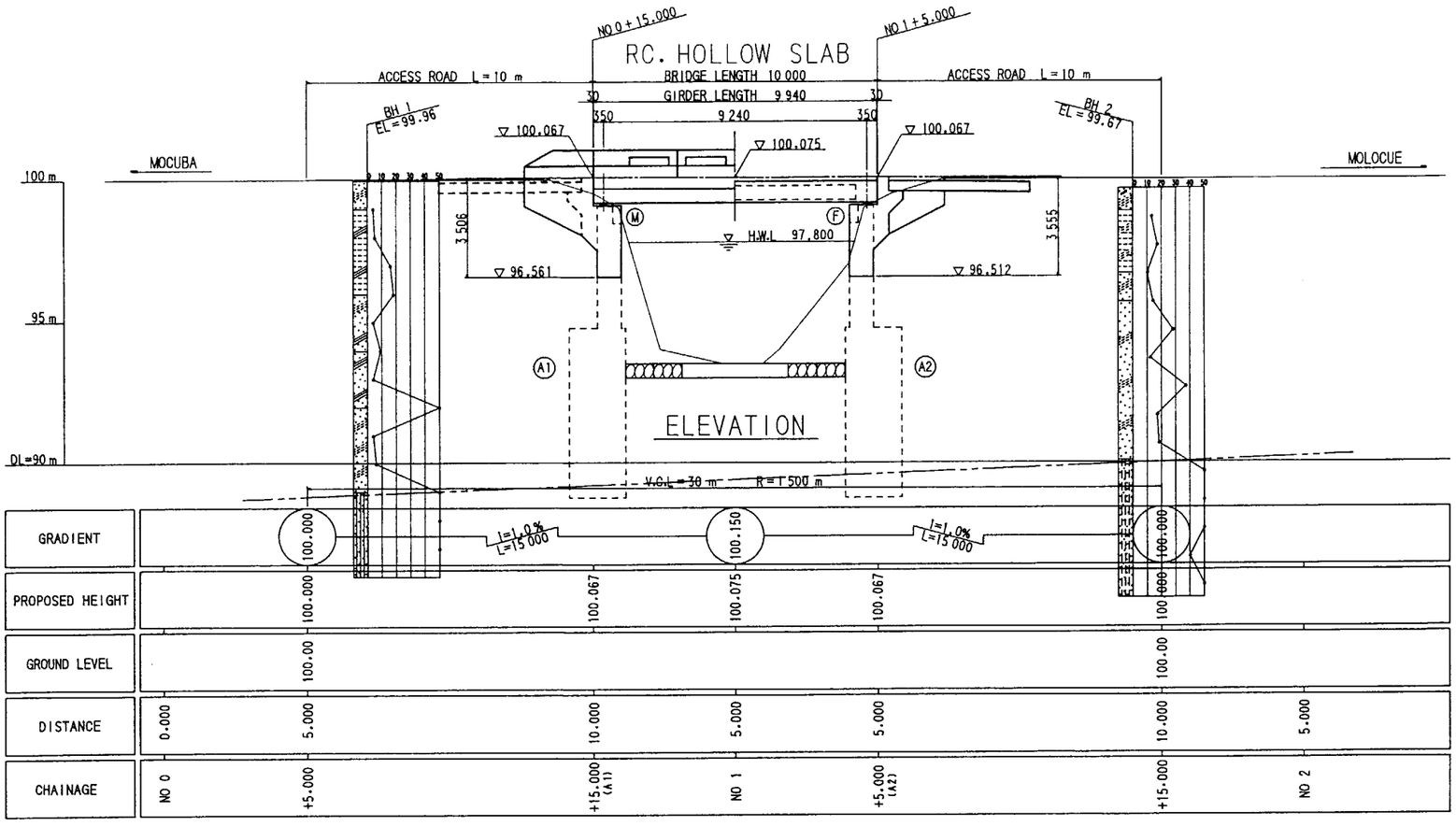
TYPICAL CROSS SECTION S = 1 : 100

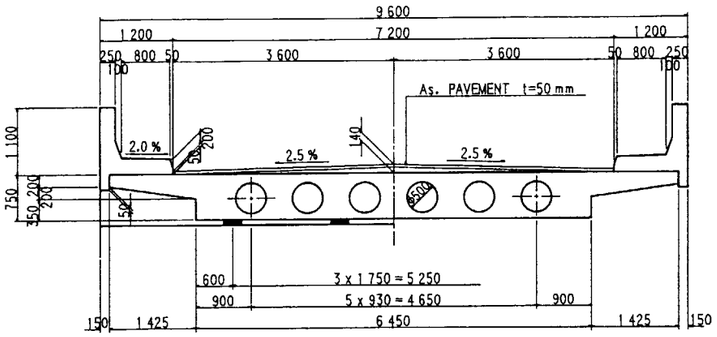


PLAN S = 1 : 500

Fig-2-15 Nicaca Bridge Access Road

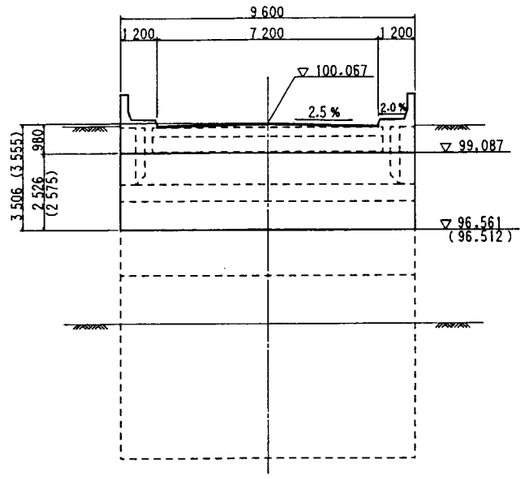
NAMILATE BRIDGE GENERAL ARRANGEMENT S=1:100



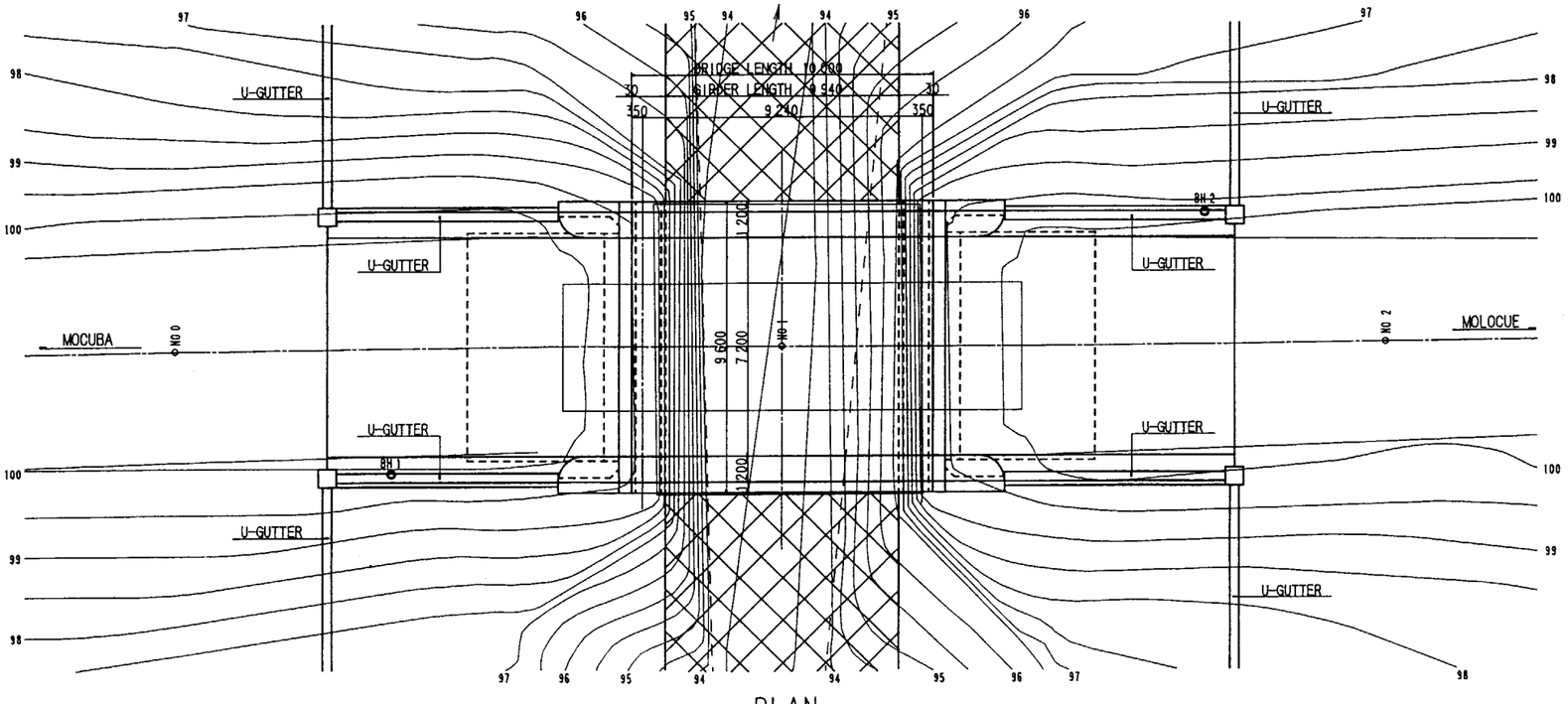


CROSS SECTION S=1:50

ABUTMENT
A1 (A2)

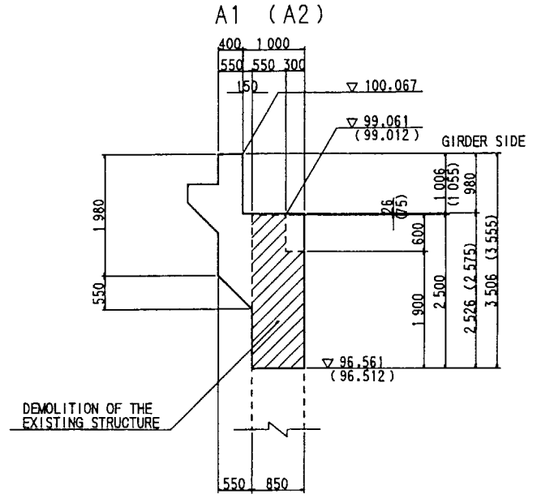


FRONT VIEW



PLAN

A1 (A2)

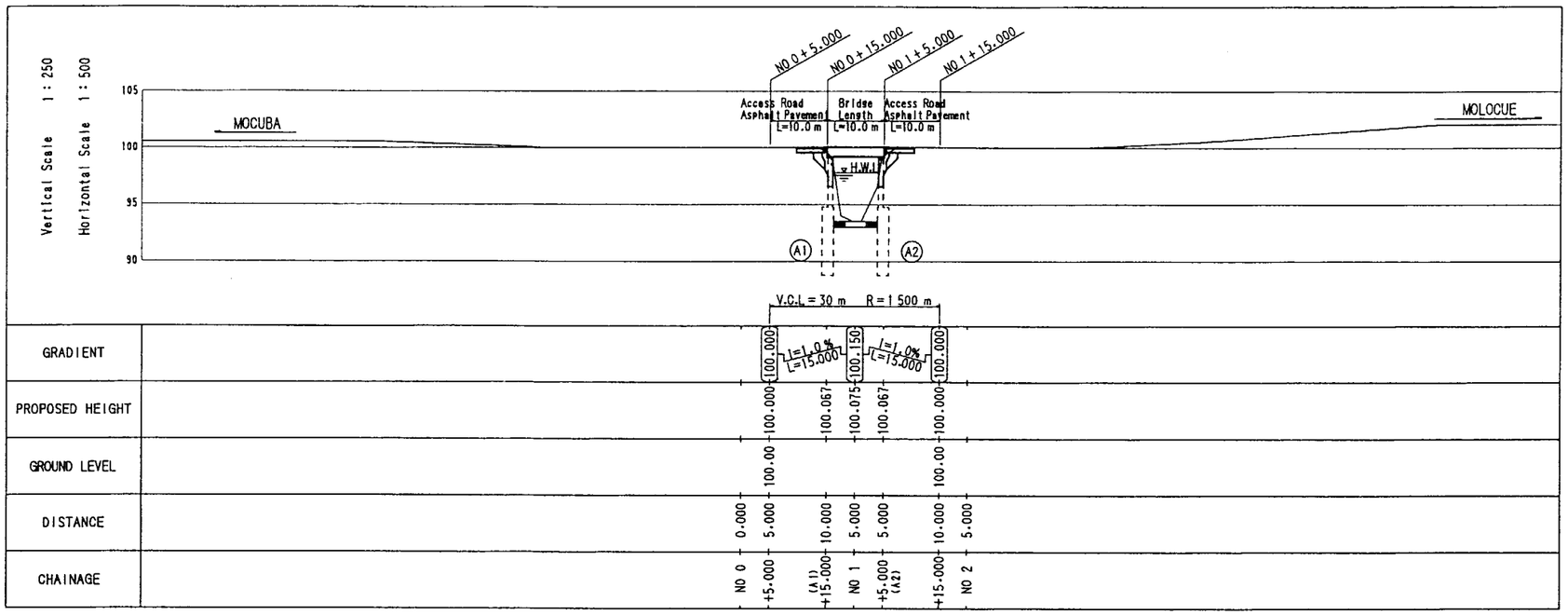


PARAPET WALL S=1:50

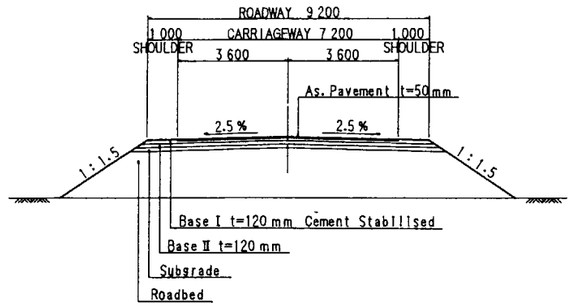
Fig-2-16 Namirate Bridge

PLAN OF ACCESS ROAD

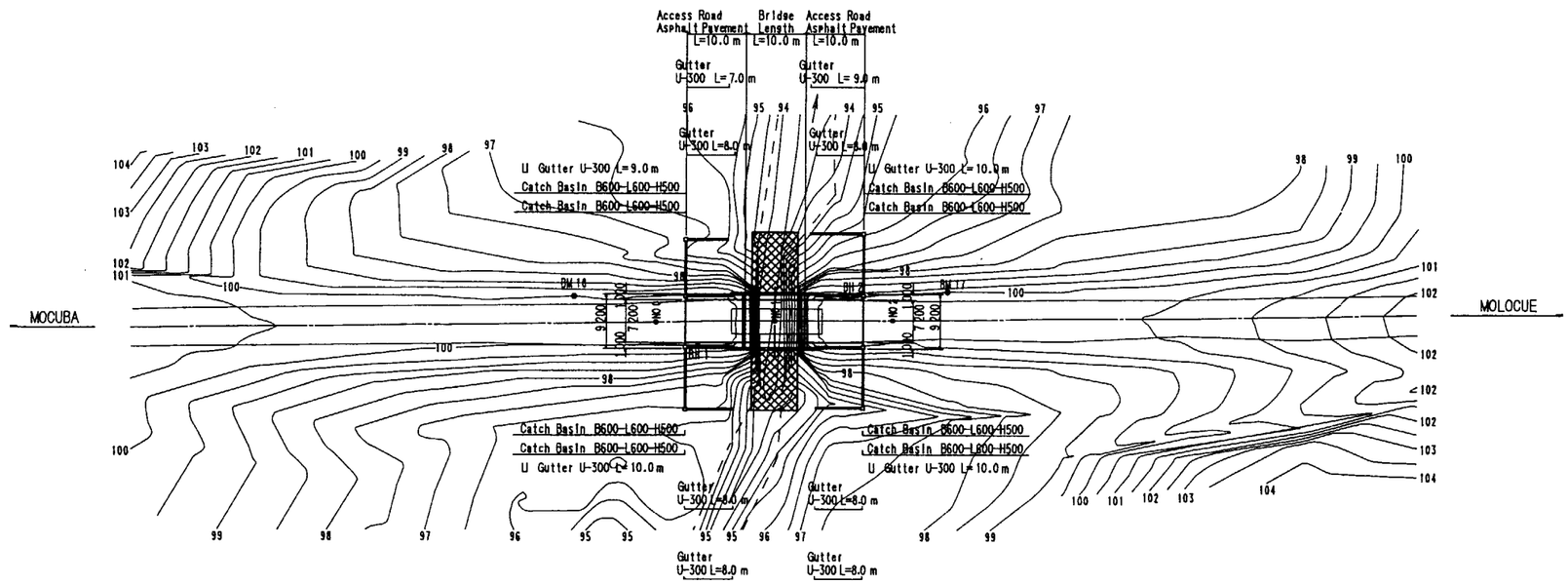
NAMILATE BRIDGE



PROFILE



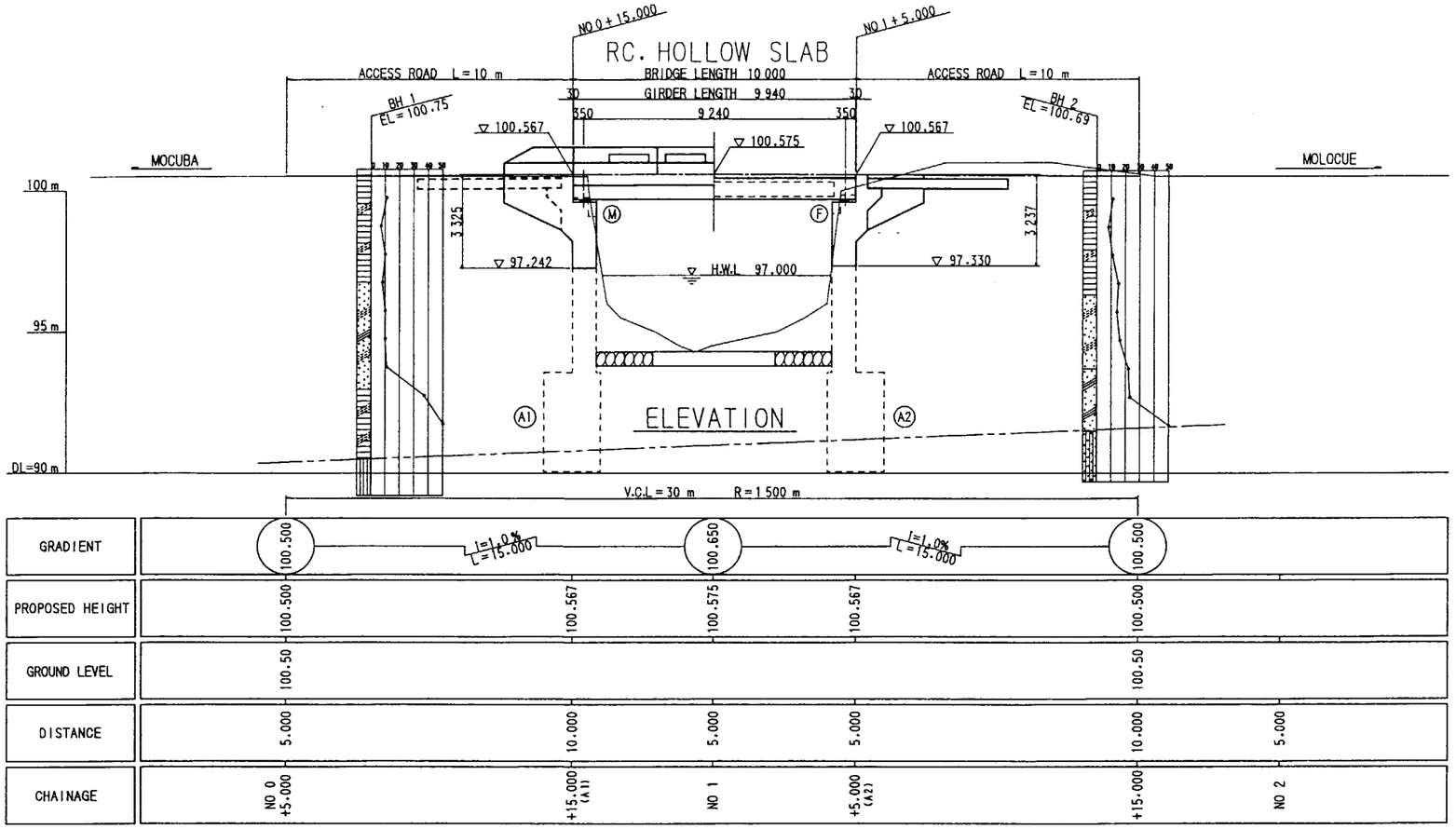
TYPICAL CROSS SECTION S = 1 : 100

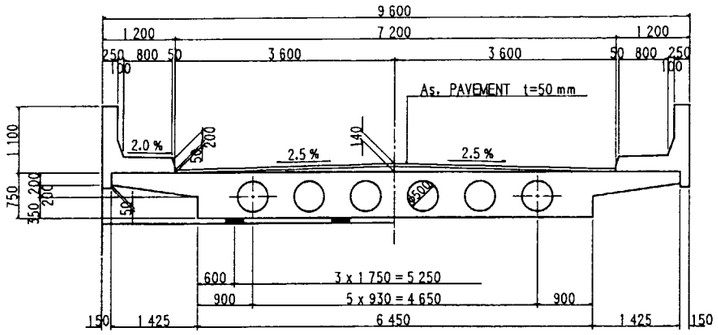


PLAN S = 1 : 500

Fig-2-17 Namirate Bridge Access Road

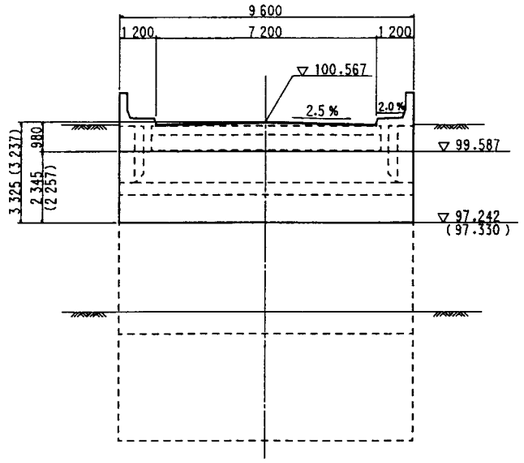
MARATA BRIDGE GENERAL ARRANGEMENT S=1:100



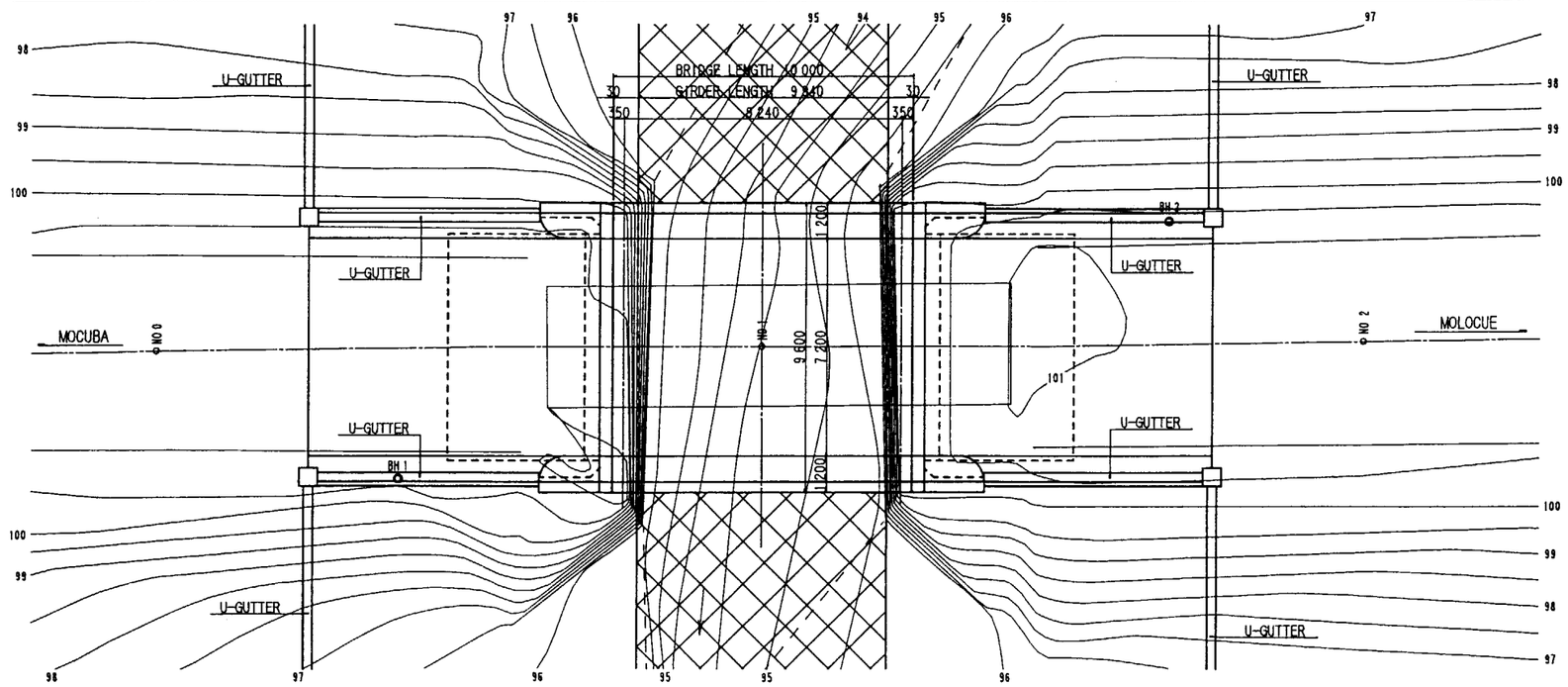


CROSS SECTION S=1:50

ABUTMENT
A1 (A2)

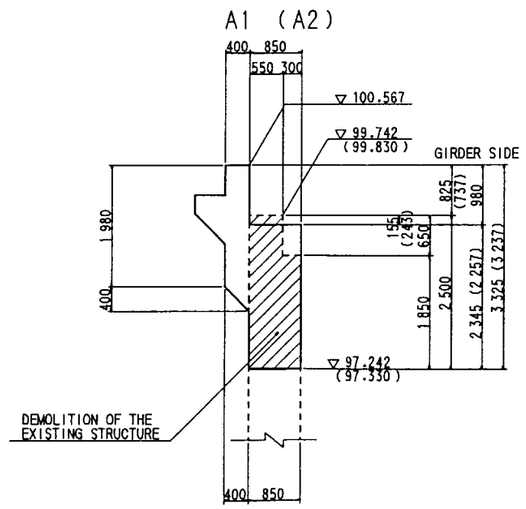


FRONT VIEW



PLAN

A1 (A2)

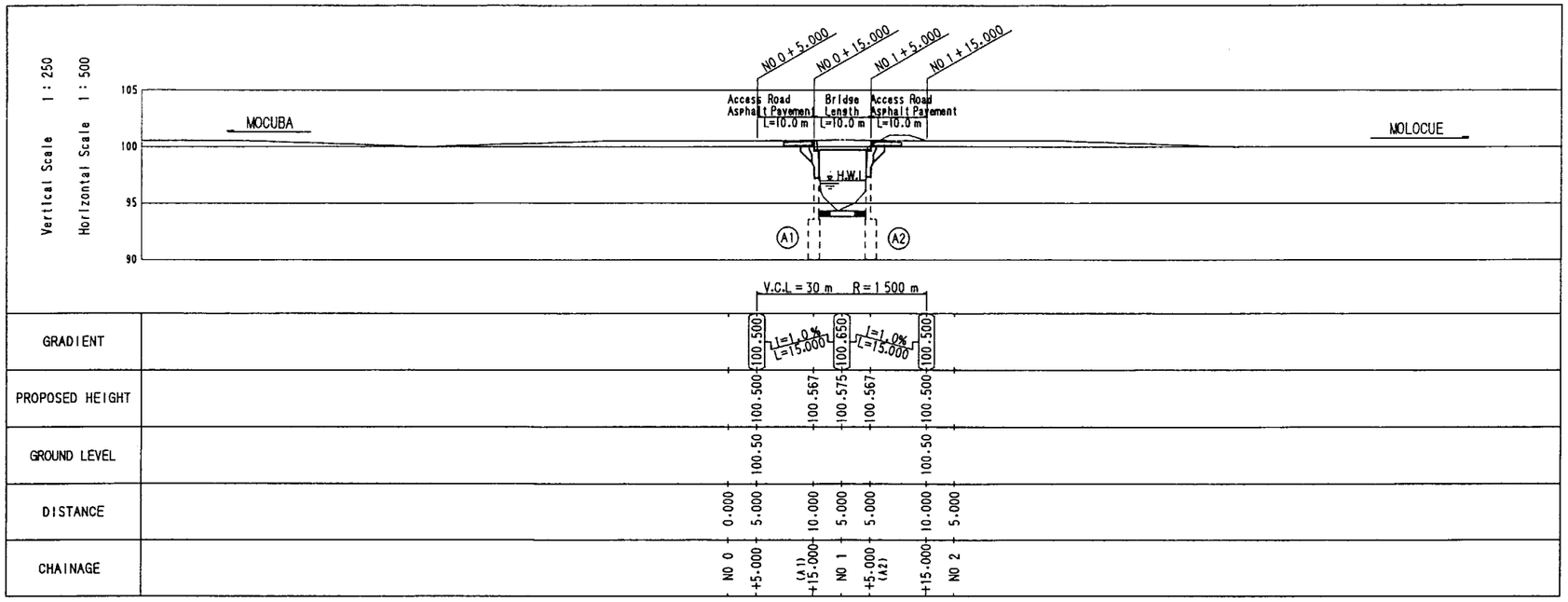


PARAPET WALL S=1:50

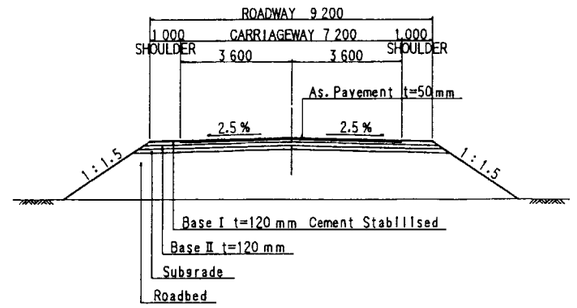
Fig-2-18 Marata Bridge

PLAN OF ACCESS ROAD

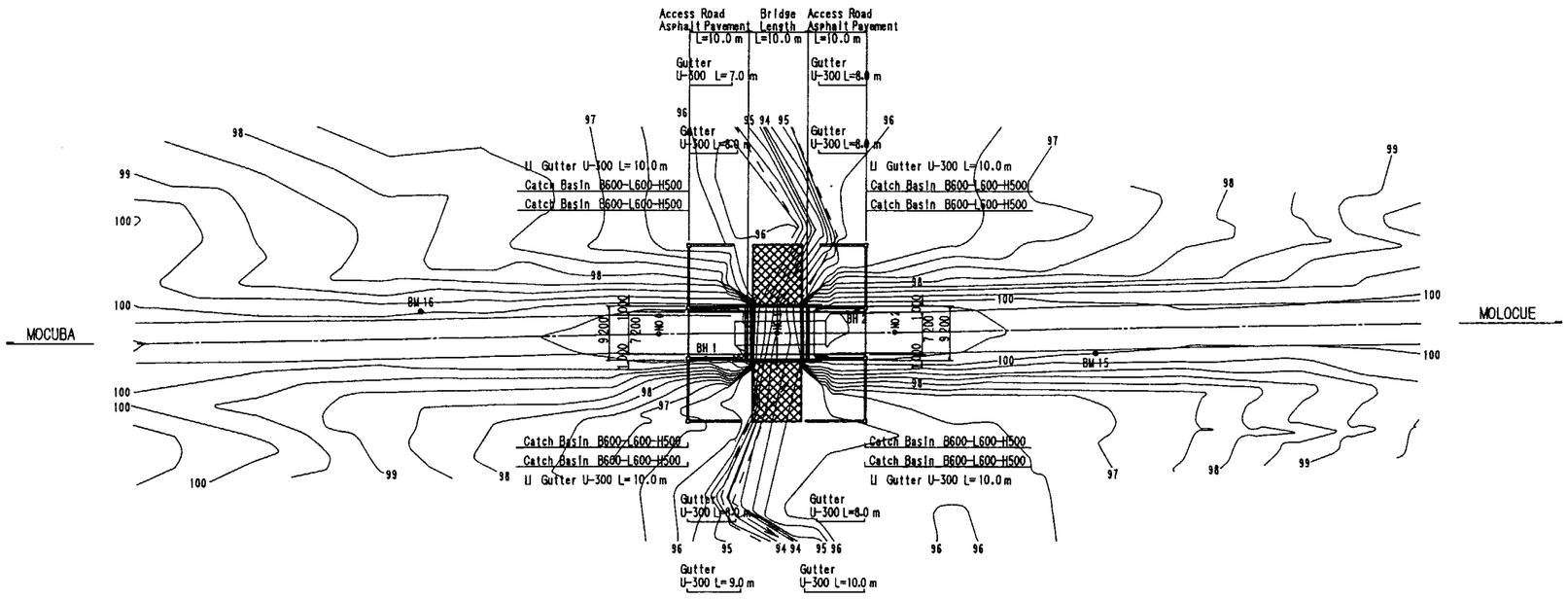
MARATA BRIDGE



PROFILE



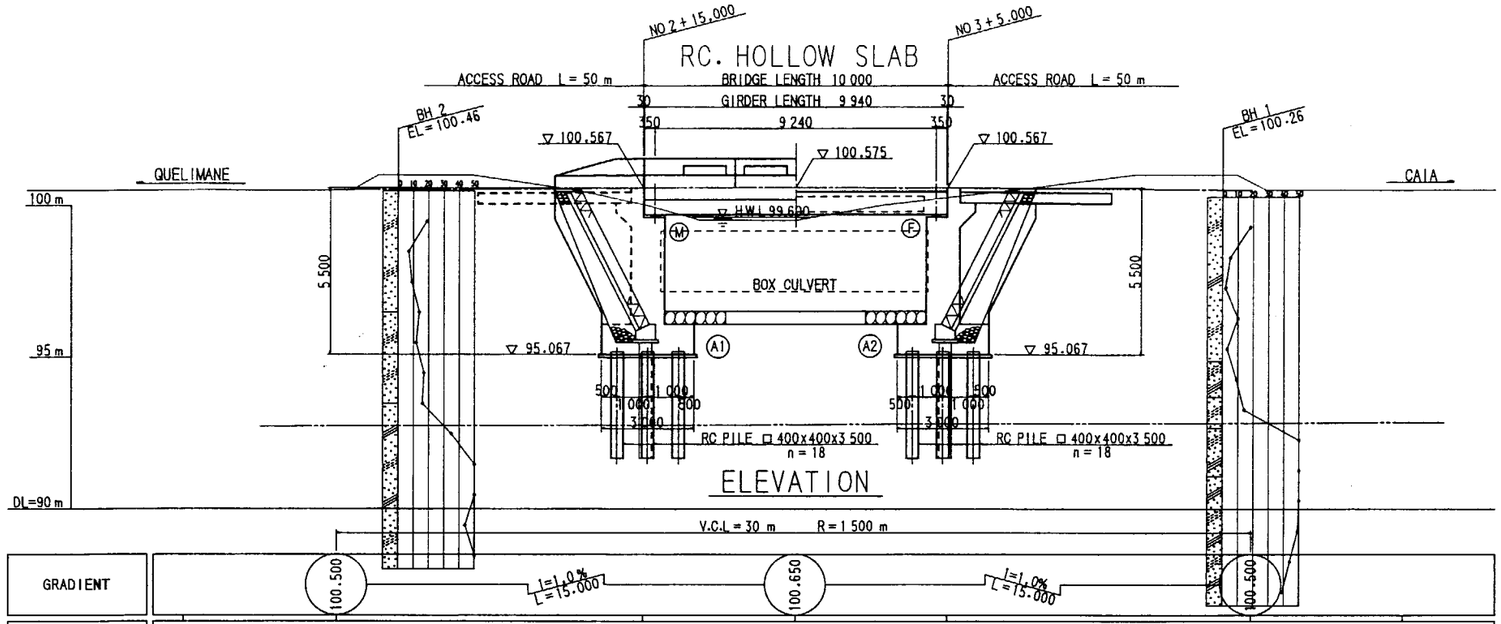
TYPICAL CROSS SECTION S = 1 : 100

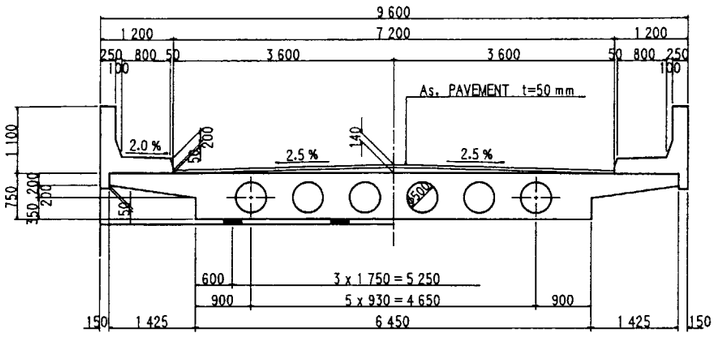


PLAN S = 1 : 500

Fig-2-19 Marata Bridge Access Road

BILILA BRIDGE GENERAL ARRANGEMENT S = 1 : 100





CROSS SECTION S = 1 : 50

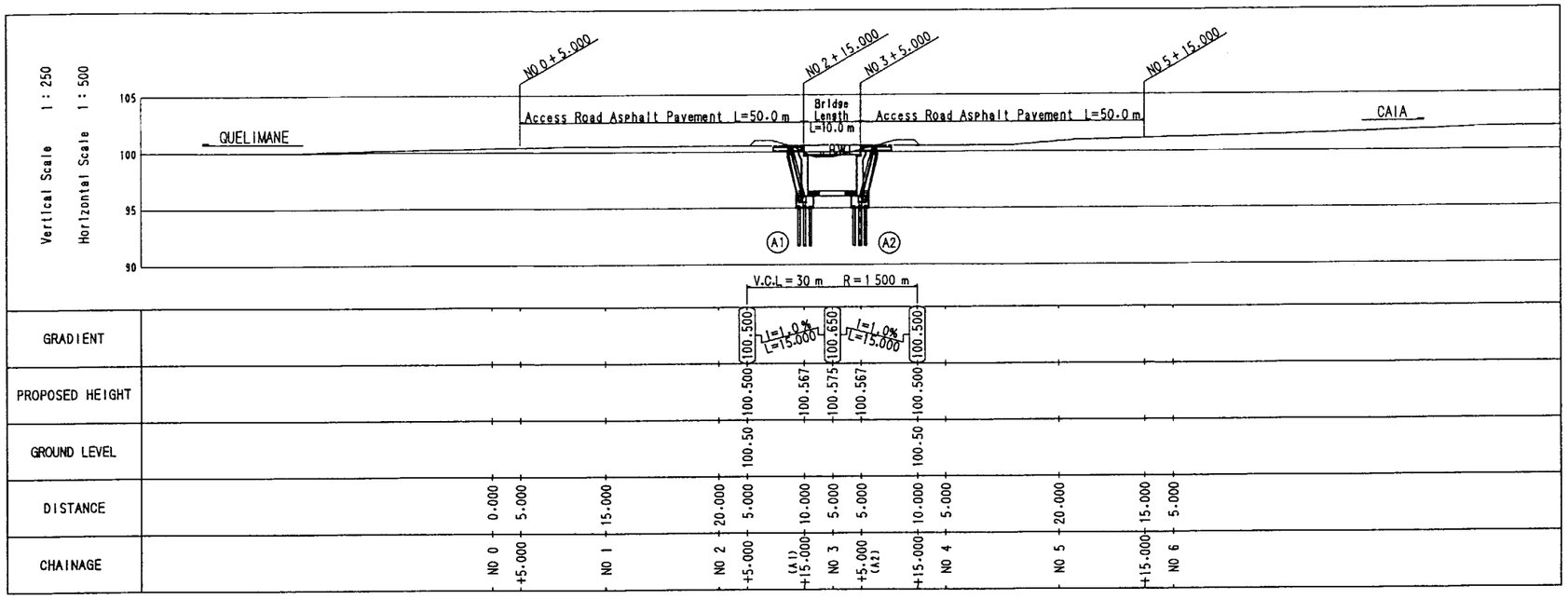
ABUTMENT
A1 A2

FRONT VIEW

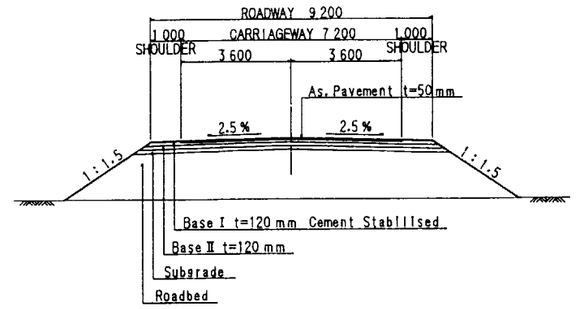
Fig-2-20 Bilila Bridge

PLAN OF ACCESS ROAD

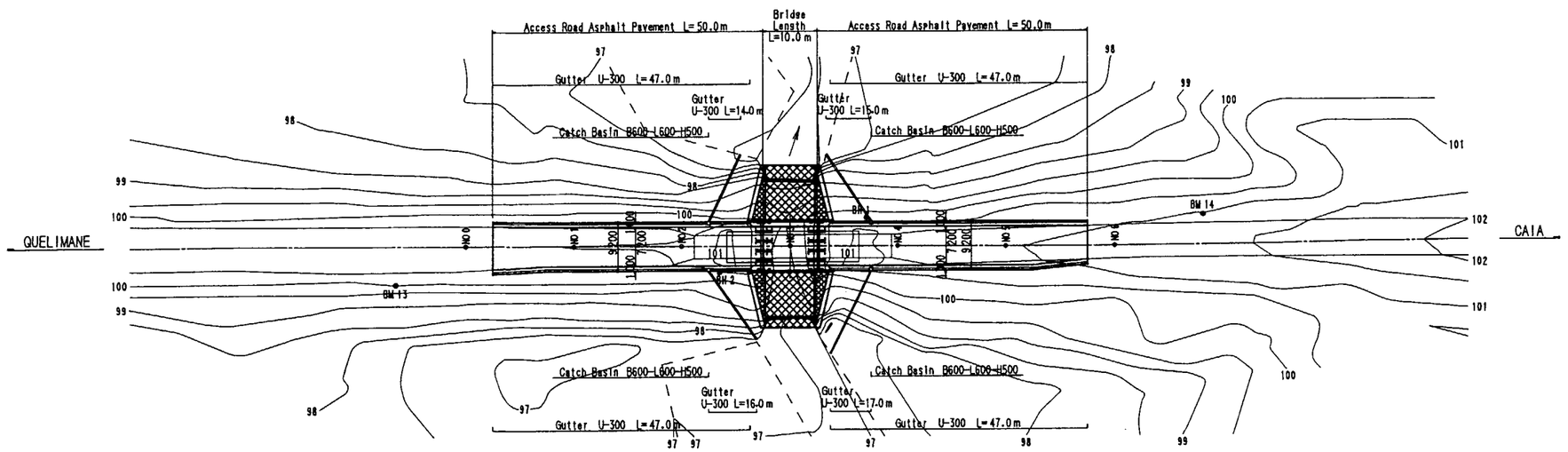
BILILA BRIDGE



PROFILE



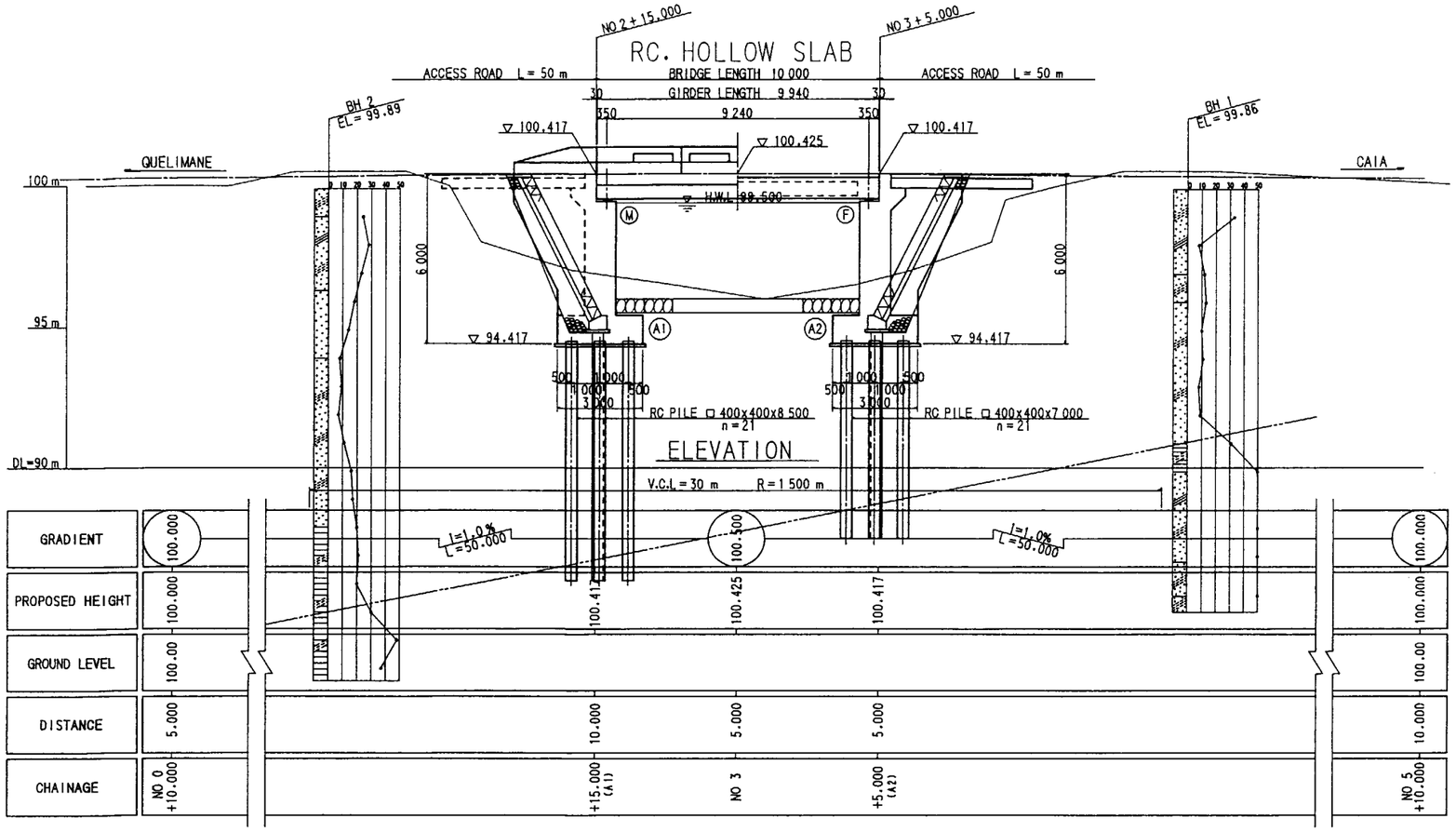
TYPICAL CROSS SECTION S=1 : 100

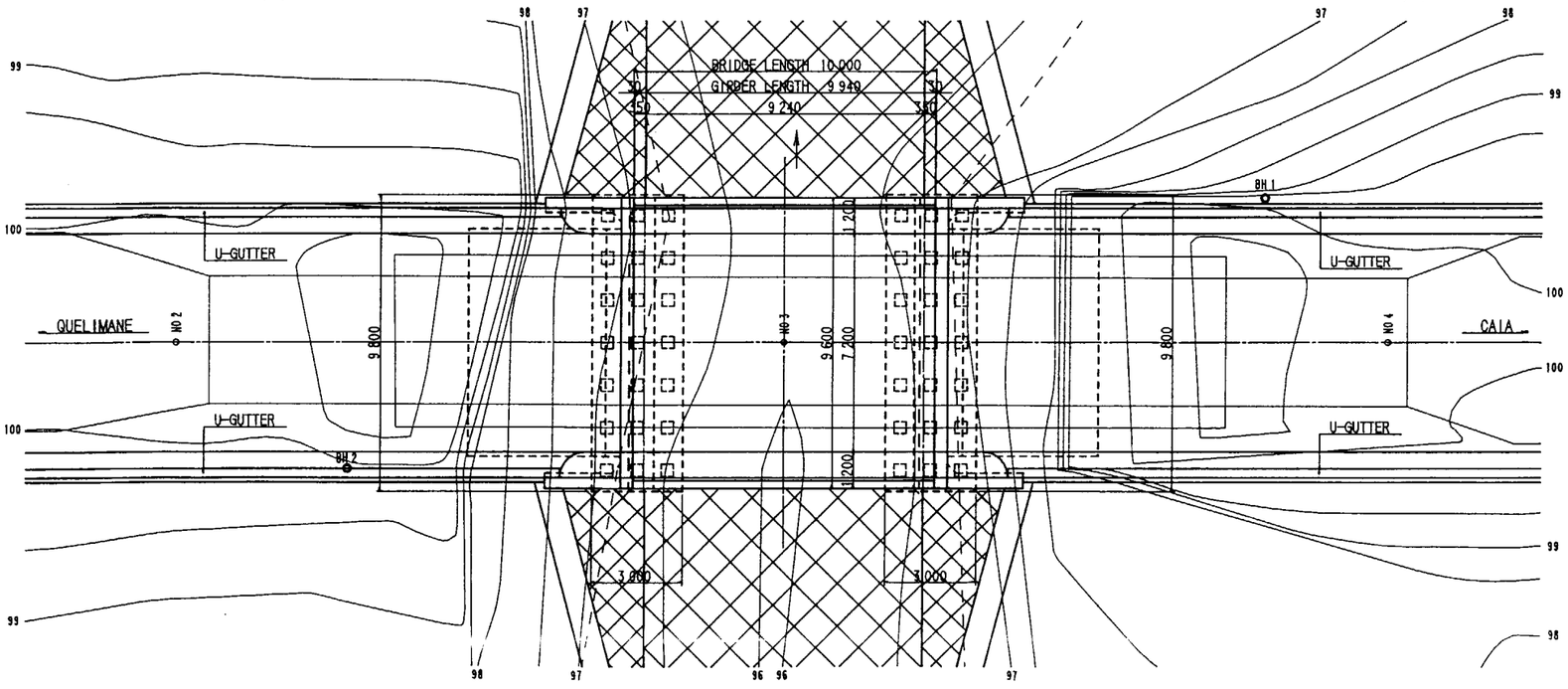


PLAN S=1 : 500

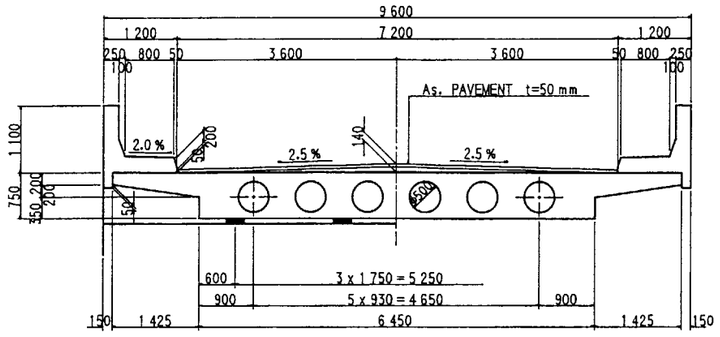
Fig-2-21 Bilila Bridge Access Road

MUNHONHA BRIDGE GENERAL ARRANGEMENT S = 1 : 100



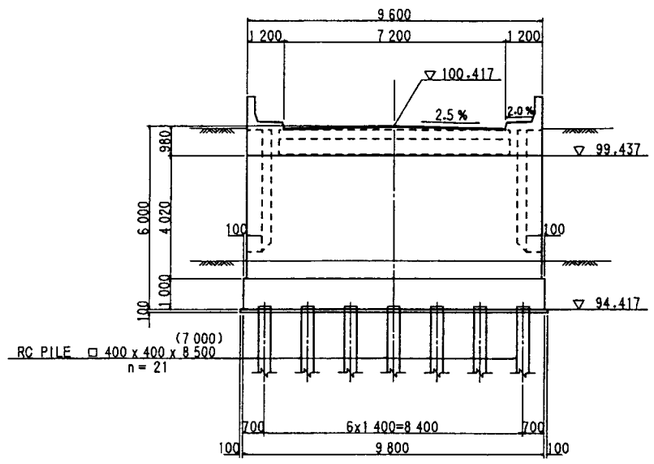


PLAN



CROSS SECTION S = 1 : 50

ABUTMENT
A1 (A2)

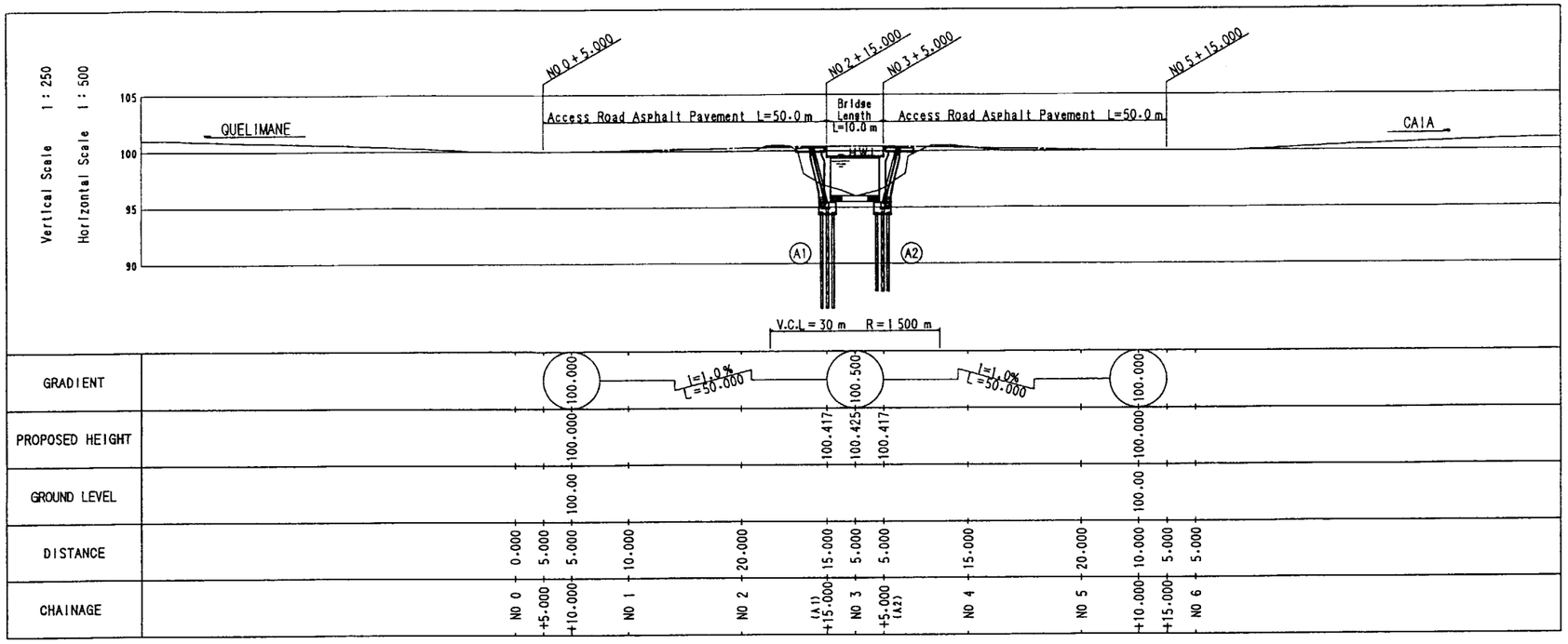


FRONT VIEW

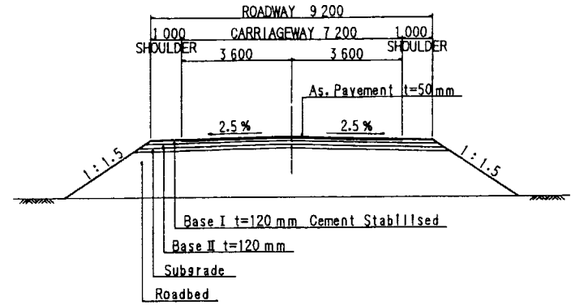
Fig-2-22 Munhonha Bridge

PLAN OF ACCESS ROAD

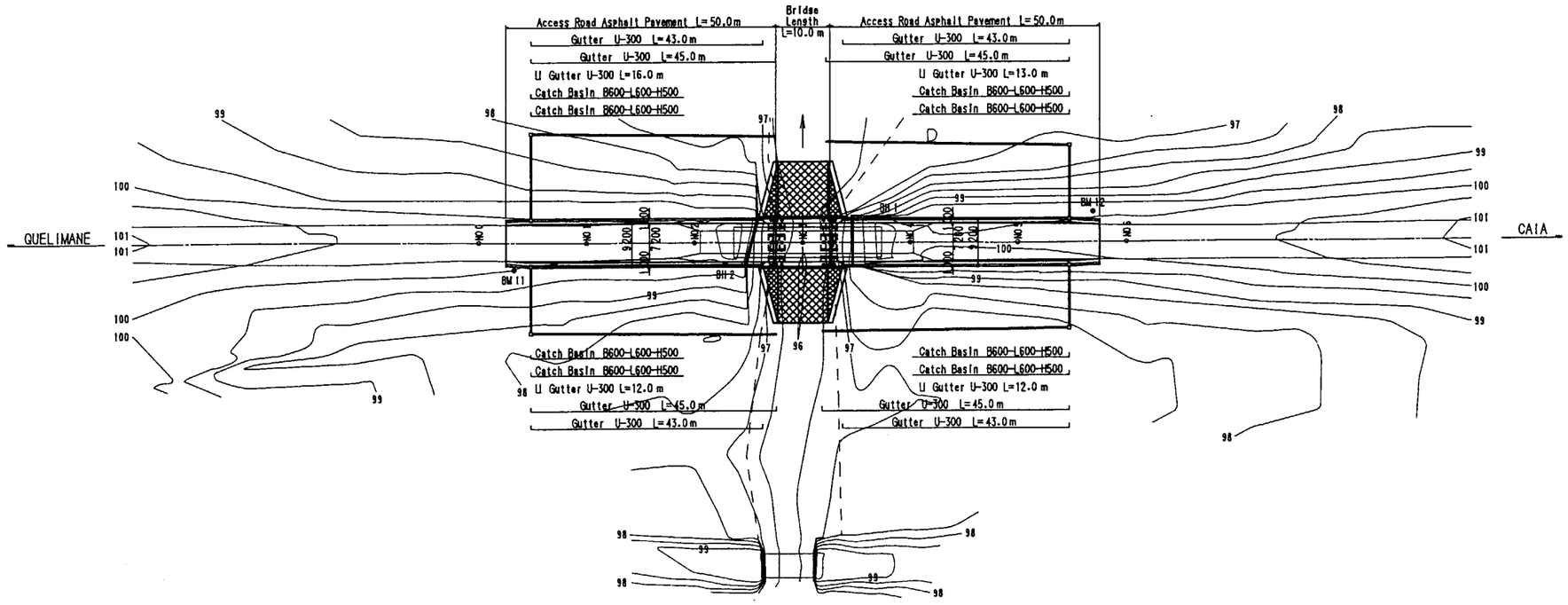
MUNHONHA BRIDGE



PROFILE



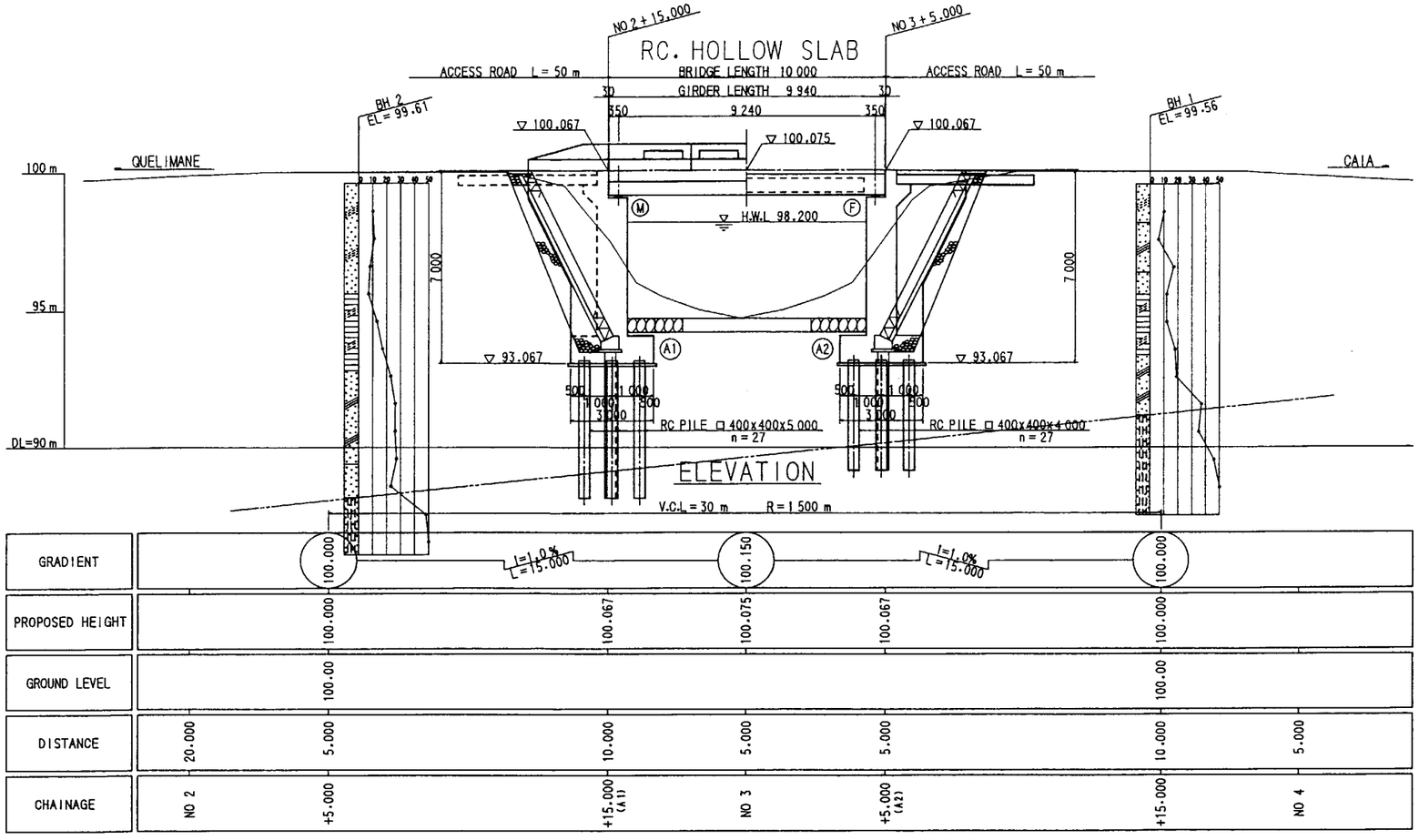
TYPICAL CROSS SECTION S = 1 : 100

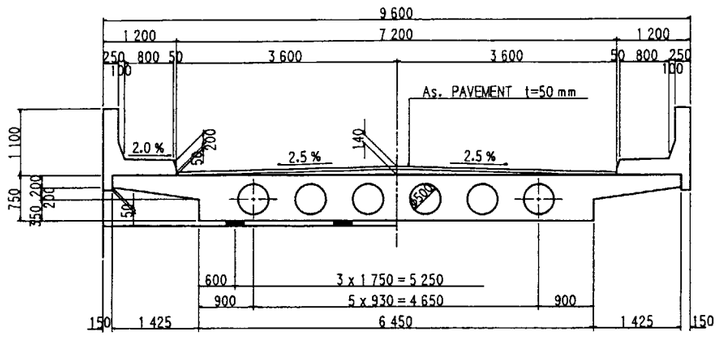


PLAN S = 1 : 500

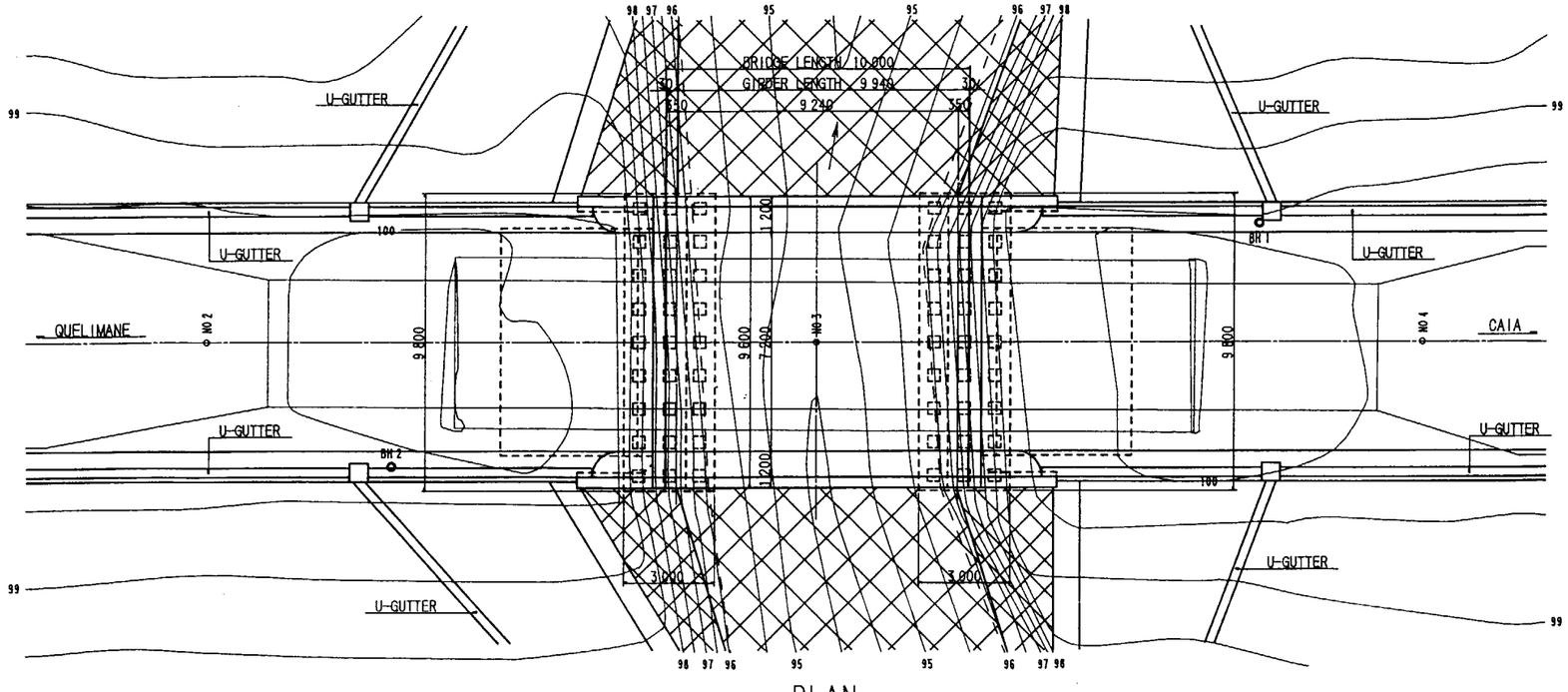
Fig-2-23 Munhonha Bridge Access Road

CHINAMAZE BRIDGE GENERAL ARRANGEMENT S = 1 : 100



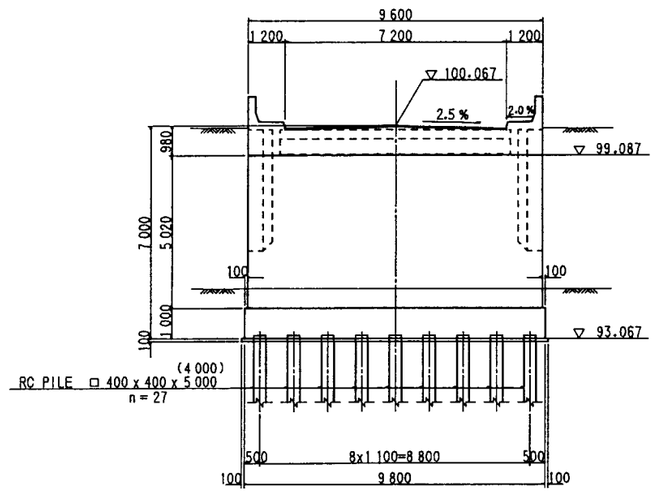


CROSS SECTION S = 1 : 50



PLAN

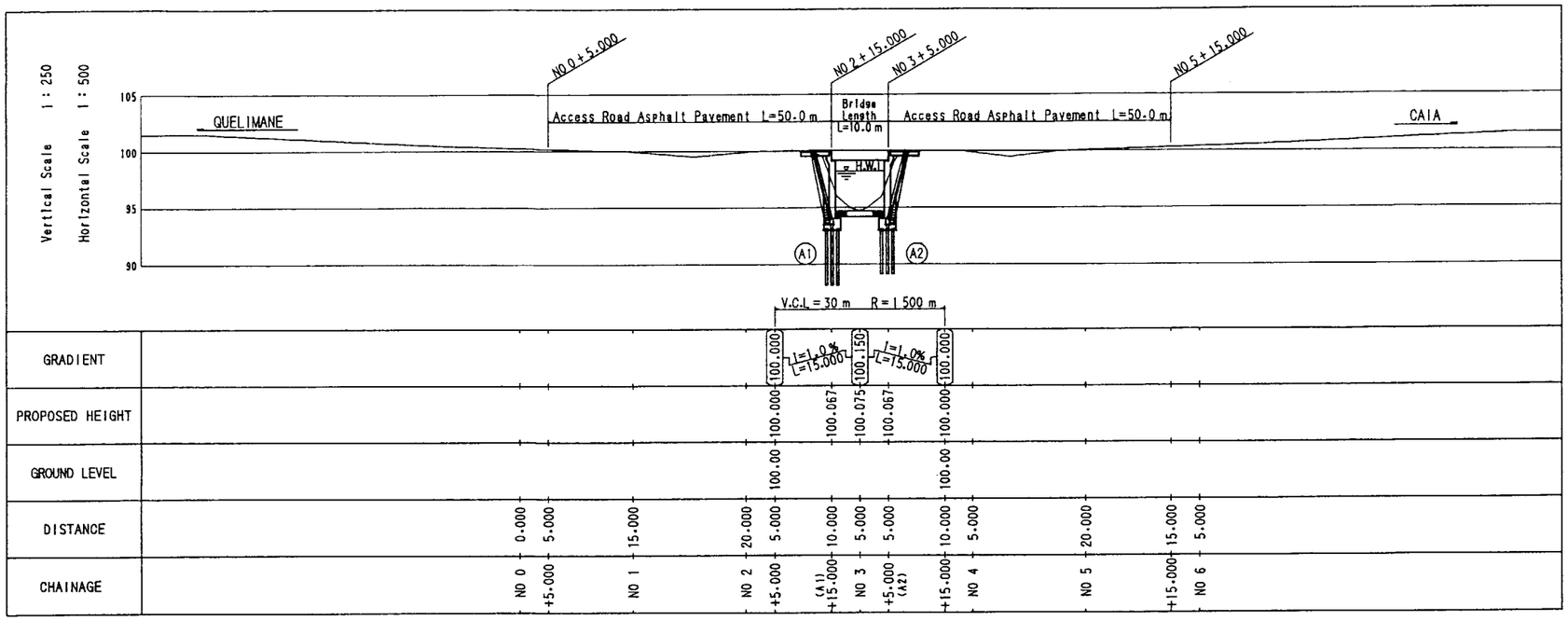
ABUTMENT
A1 (A2)



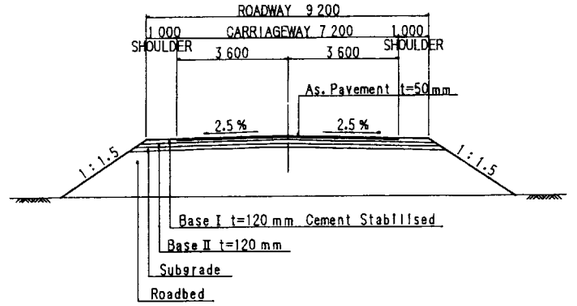
FRONT VIEW

Fig-2-24 Chinamaze Bridge

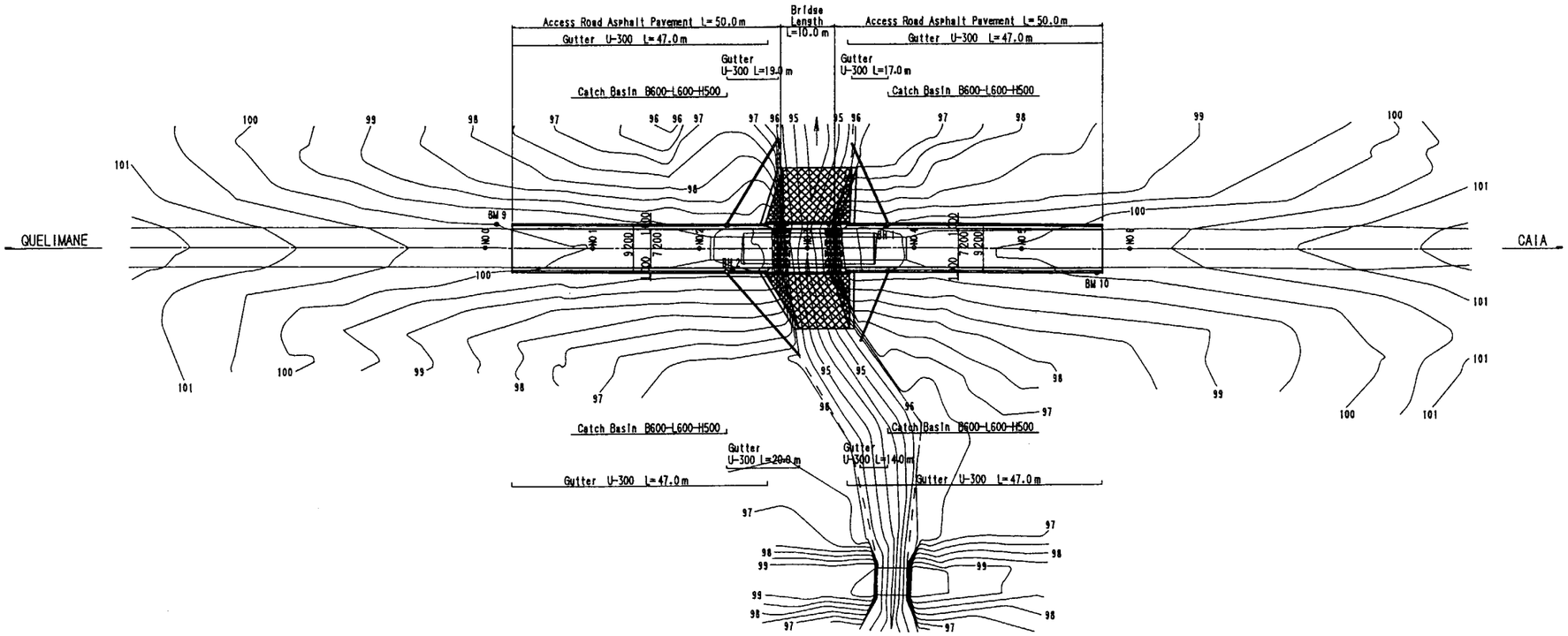
PLAN OF ACCESS ROAD　CHINAMAZE BRIDGE



PROFILE



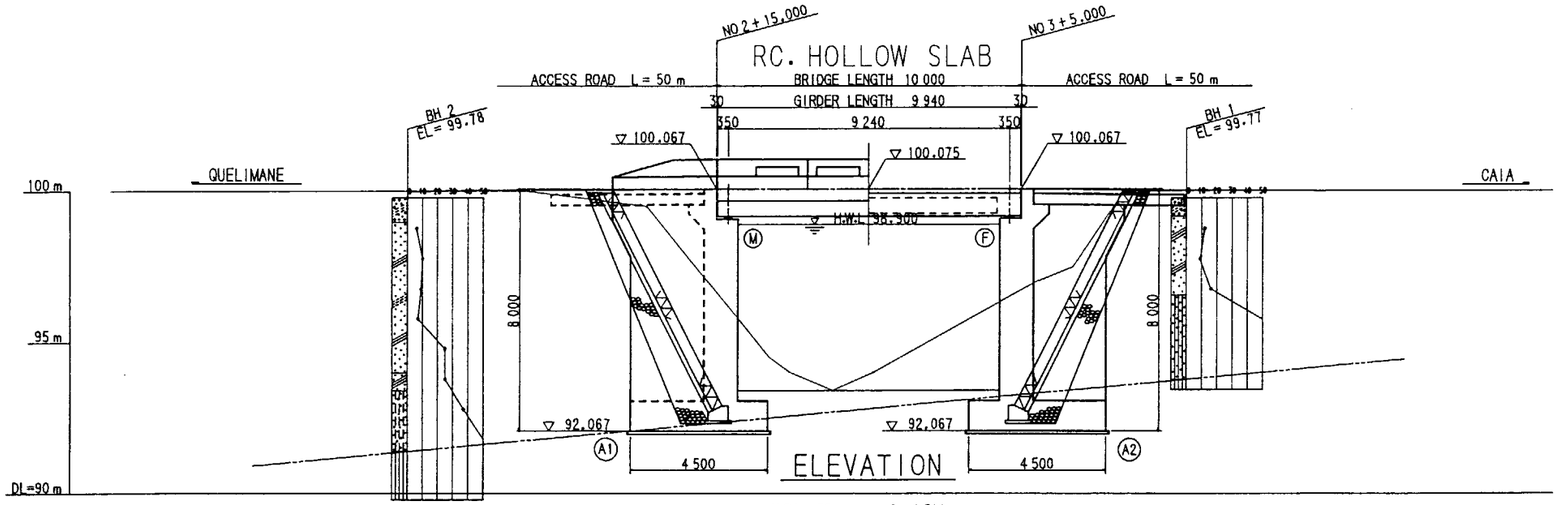
TYPICAL CROSS SECTION　S = 1 : 100

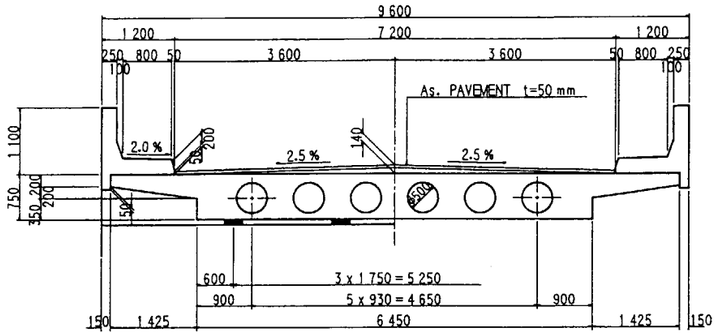


PLAN　S = 1 : 500

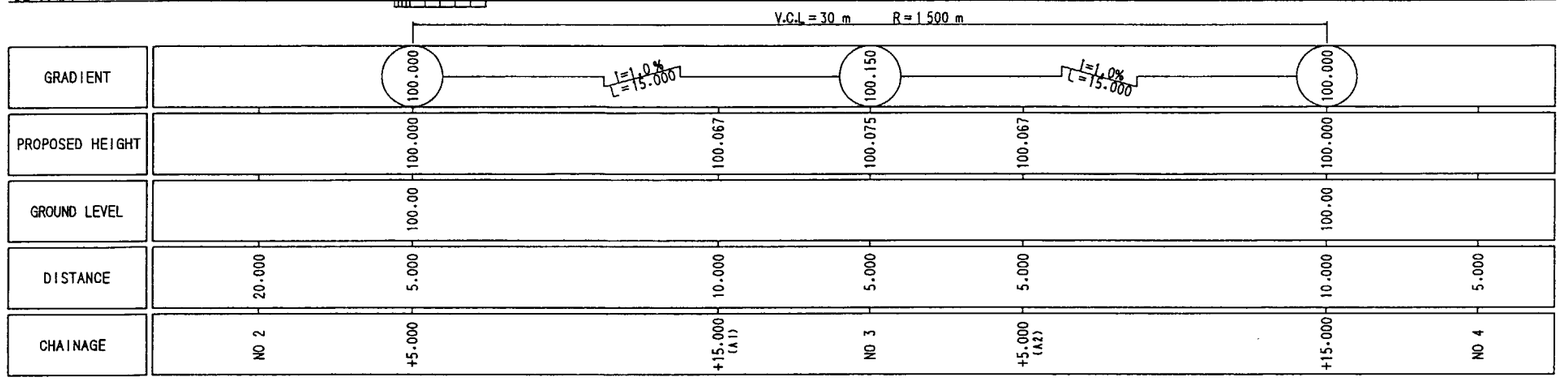
Fig-2-25 Chinamaze Bridge Access Road

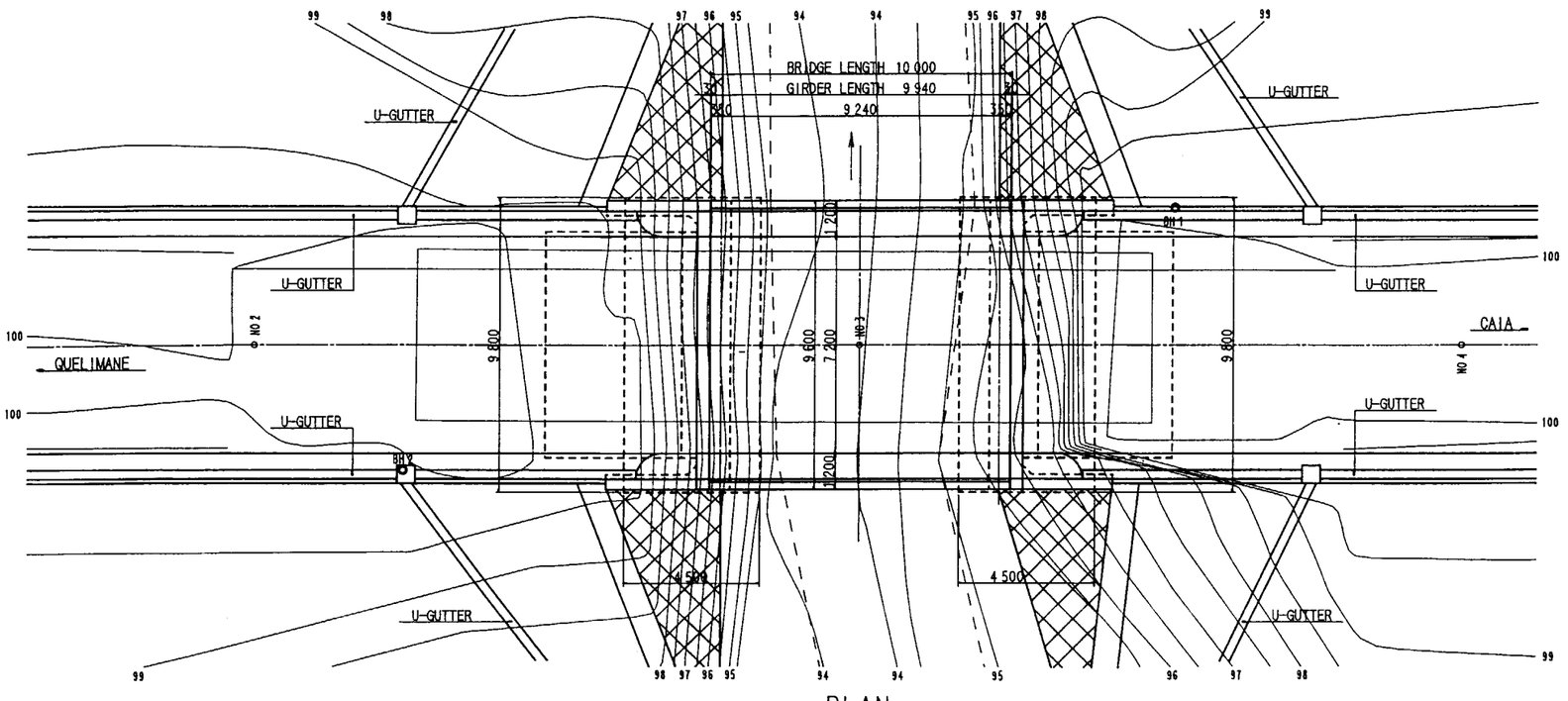
SINONONO BRIDGE GENERAL ARRANGEMENT S=1:100





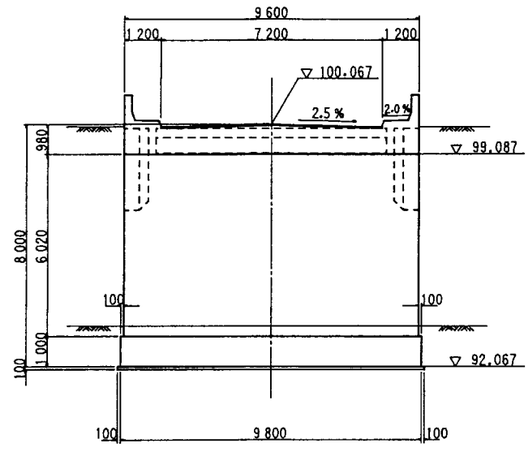
CROSS SECTION S=1:50





PLAN

ABUTMENT
A1 A2

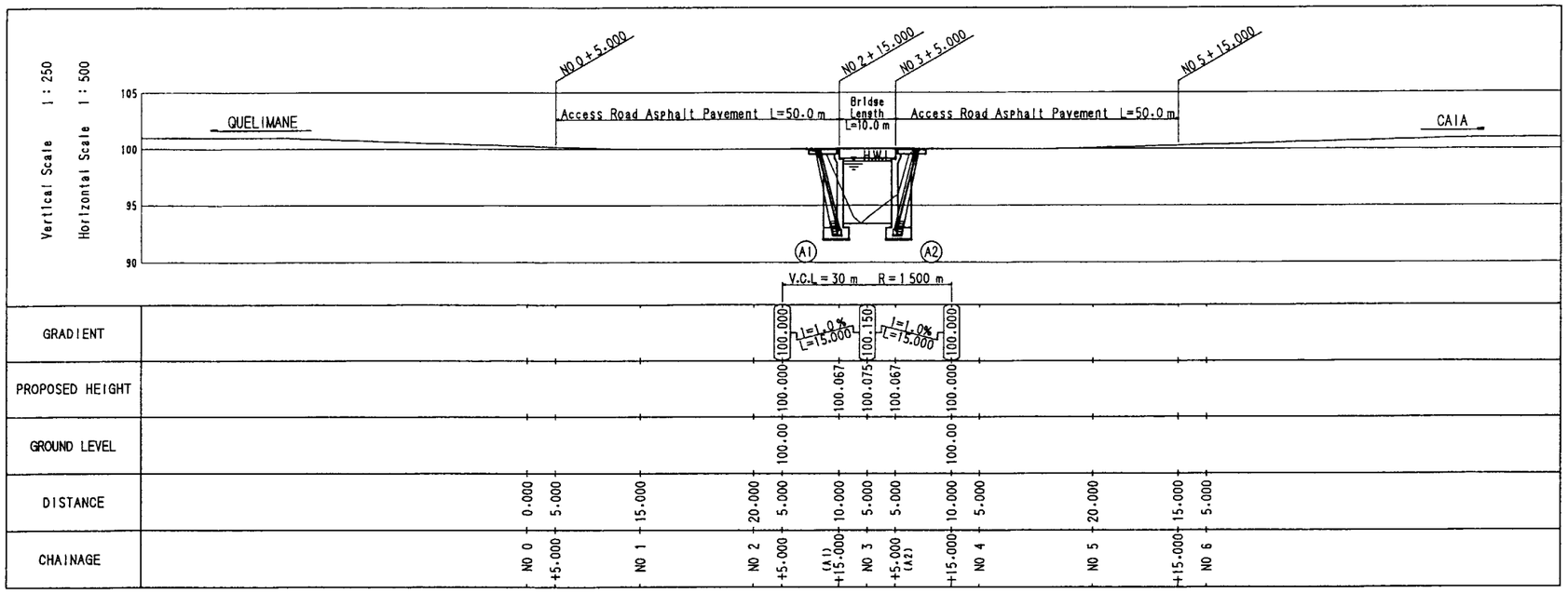


FRONT VIEW

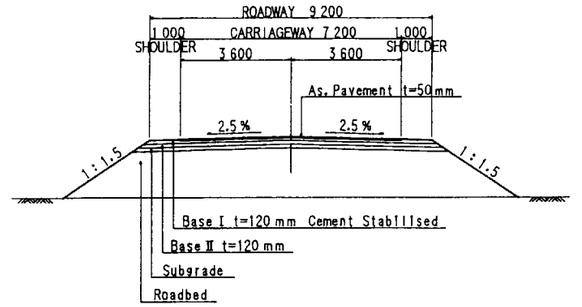
Fig-2-26 Sinonono Bridge

PLAN OF ACCESS ROAD

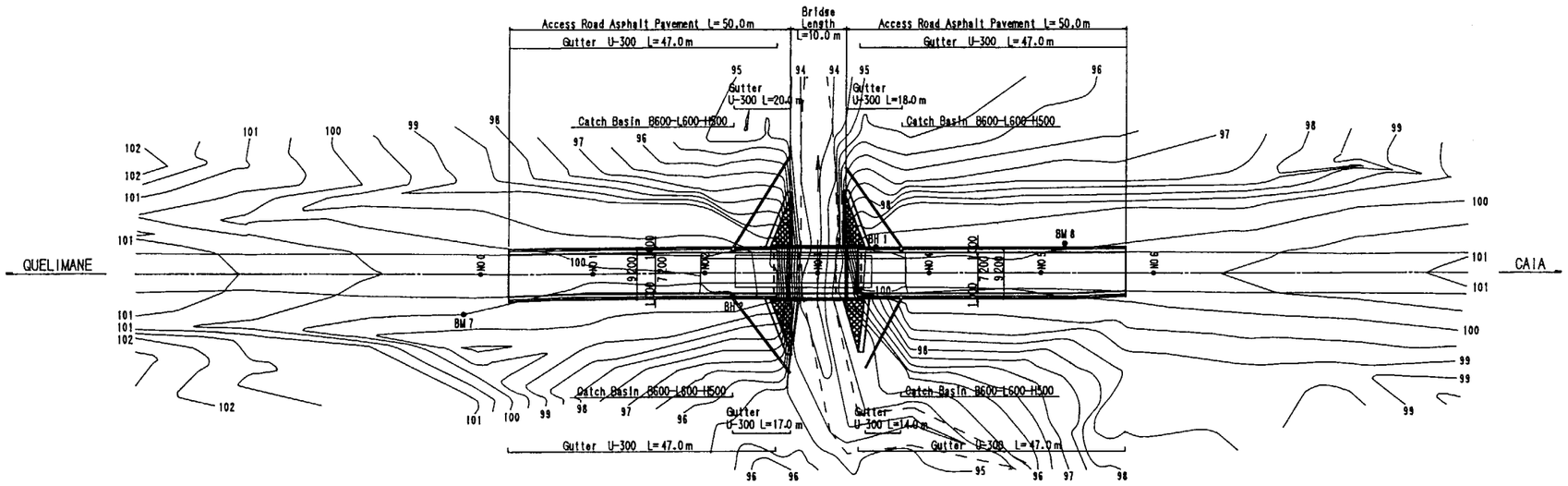
SINONONO BRIDGE



PROFILE



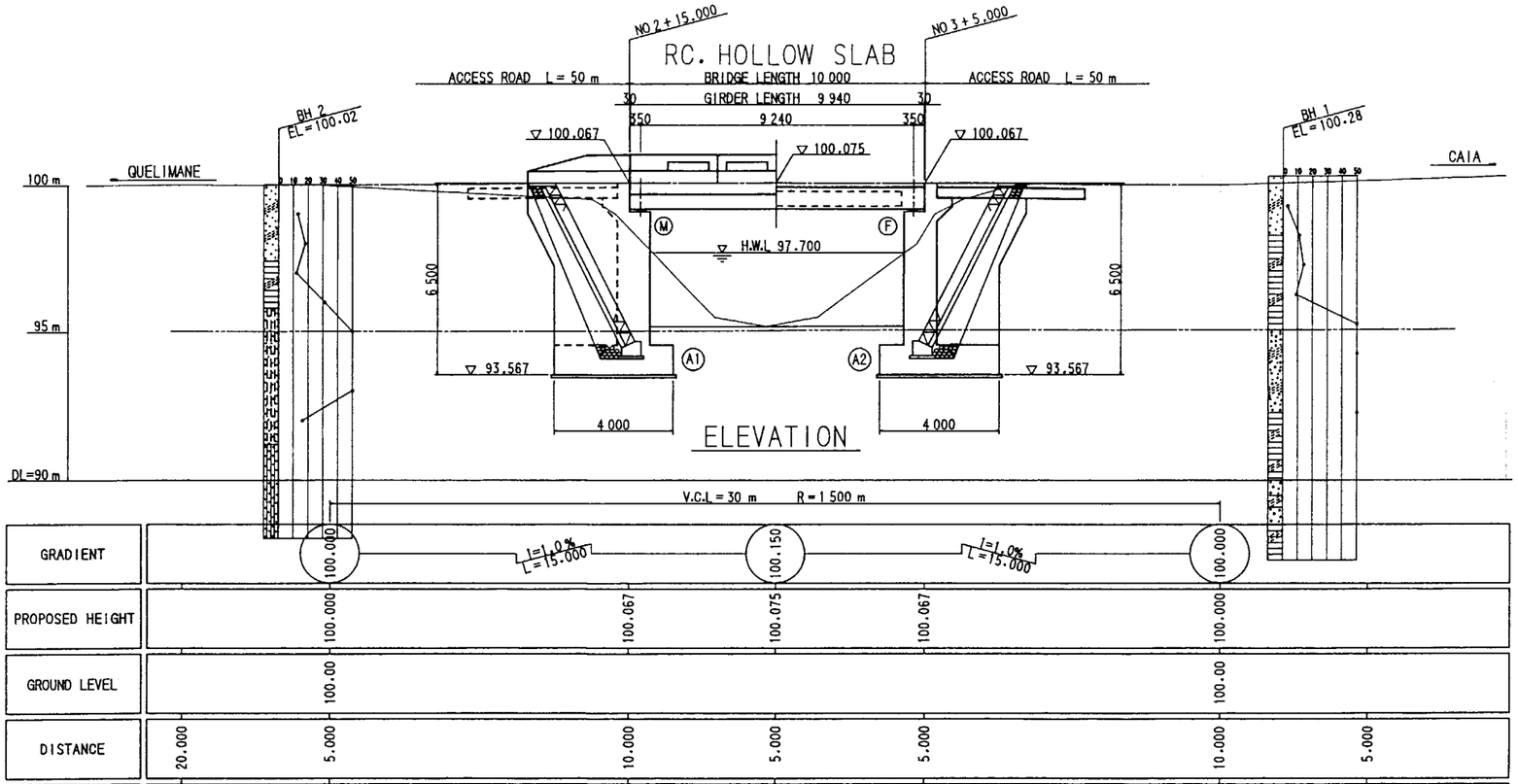
TYPICAL CROSS SECTION S = 1 : 100

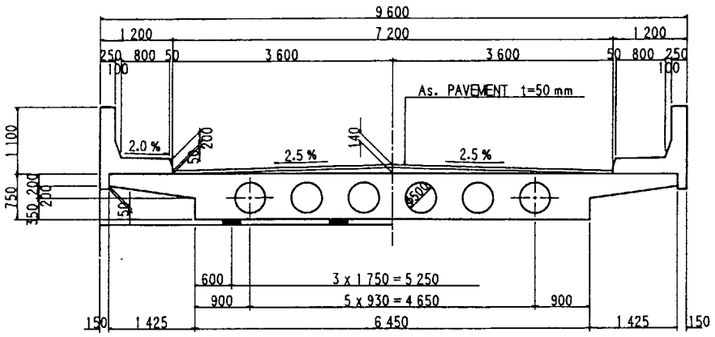


PLAN S = 1 : 500

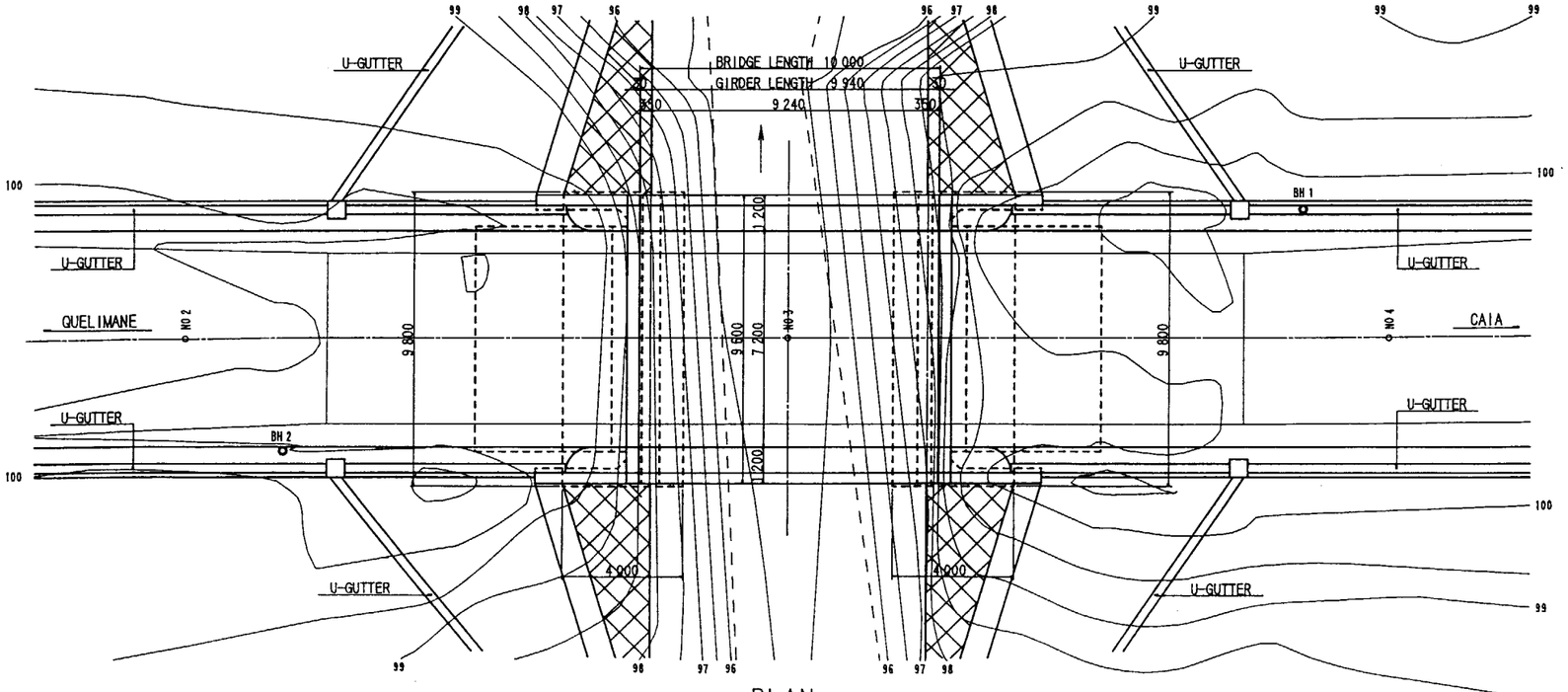
Fig-2-27 Sinonono Bridge Access Road

NHAMIHUNGO BRIDGE GENERAL ARRANGEMENT S=1:100





CROSS SECTION S=1:50



PLAN

ABUTMENT

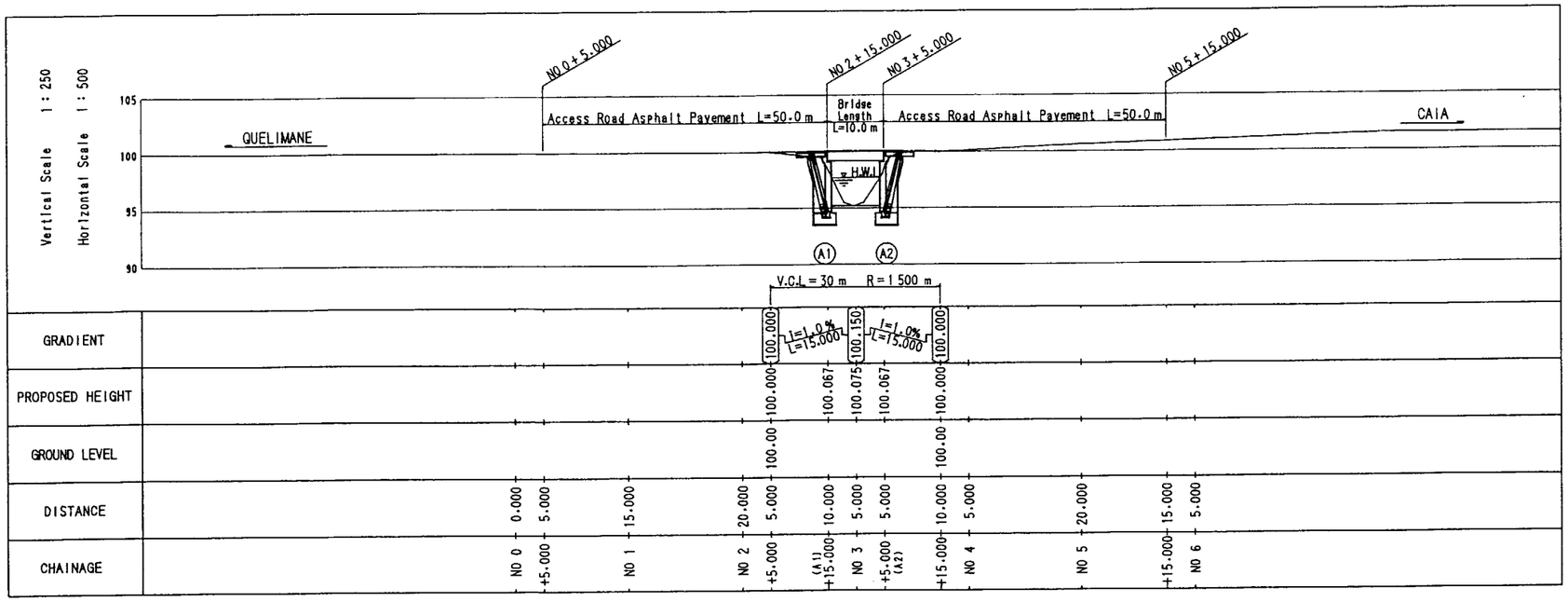
A1 A2

FRONT VIEW

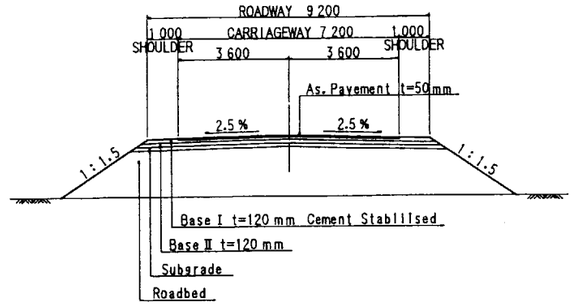
Fig-2-28 Namihungo Bridge

PLAN OF ACCESS ROAD

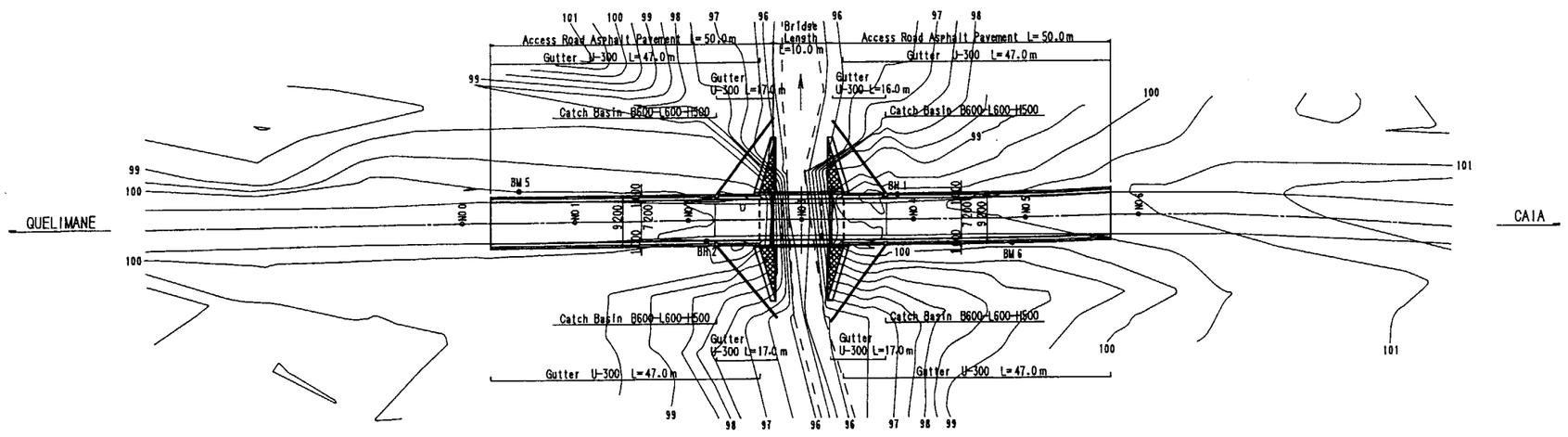
NHAMIHUNGO BRIDGE



PROFILE



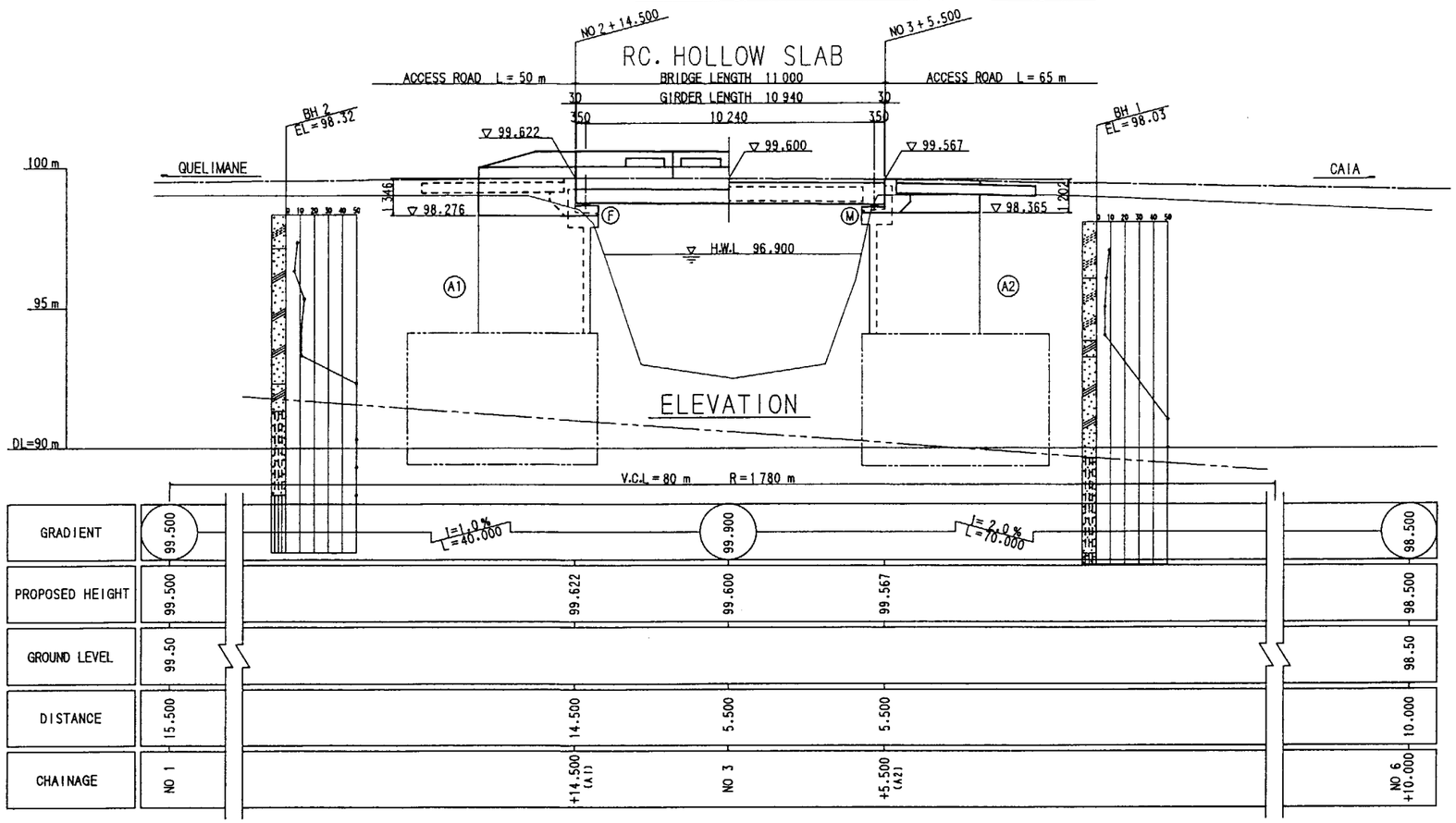
TYPICAL CROSS SECTION S = 1 : 100

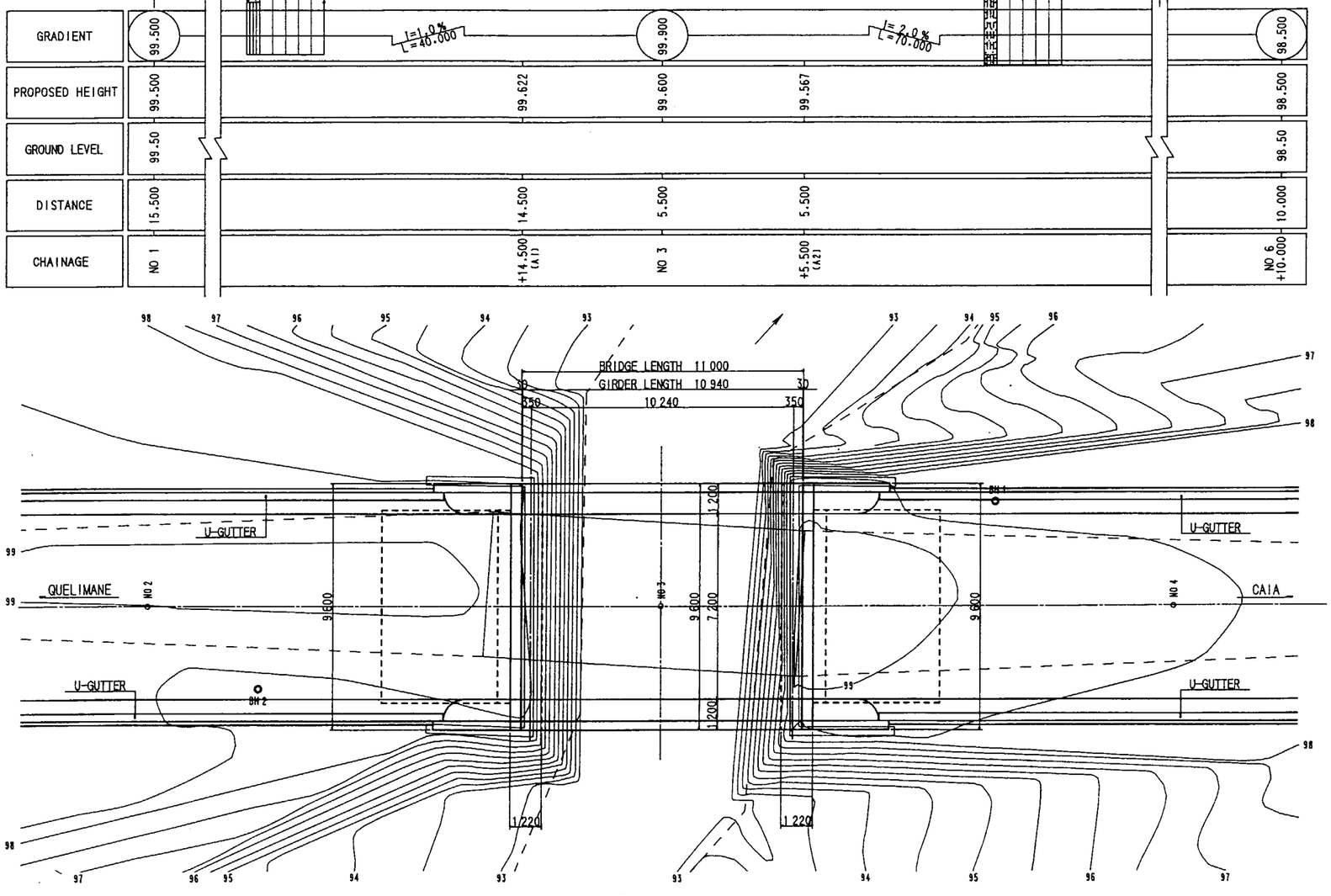


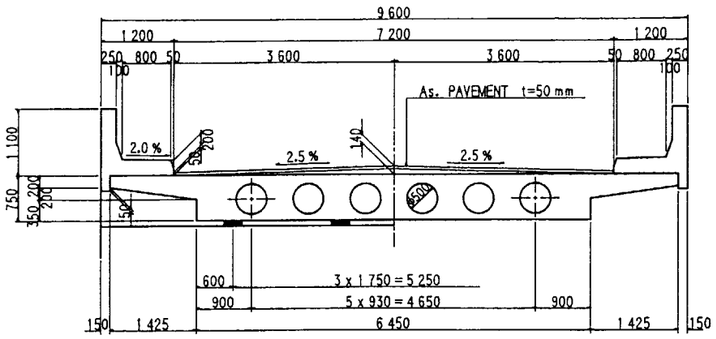
PLAN S = 1 : 500

Fig-2-29 Namihungo Bridge Access Road

SAMBALENDO BRIDGE GENERAL ARRANGEMENT S=1:100

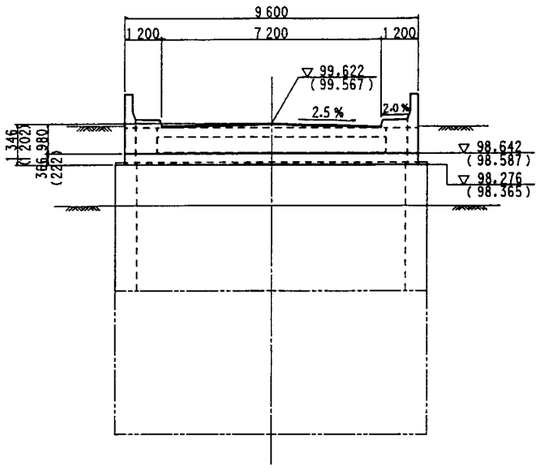






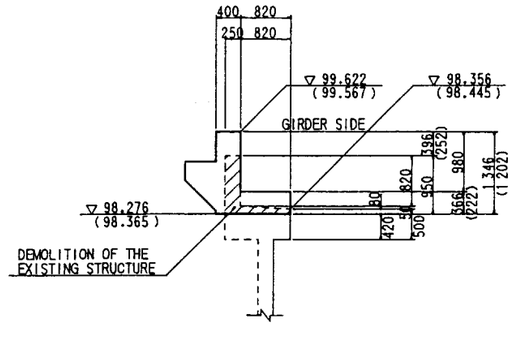
CROSS SECTION S=1:50

ABUTMENT
A1 (A2)



FRONT VIEW

A1 (A2)

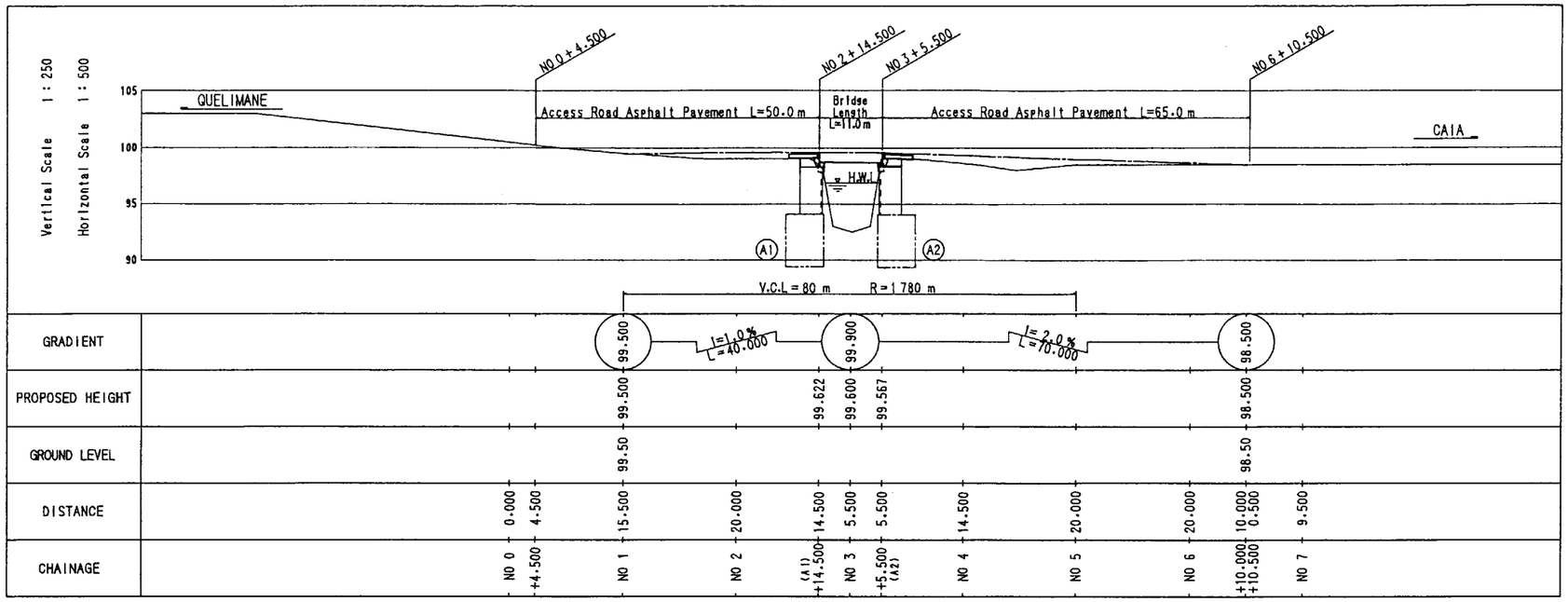


PARAPET WALL S=1:50

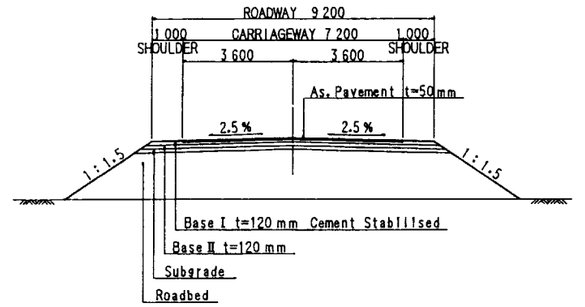
Fig-2-30 Sambalendo Bridge

PLAN OF ACCESS ROAD

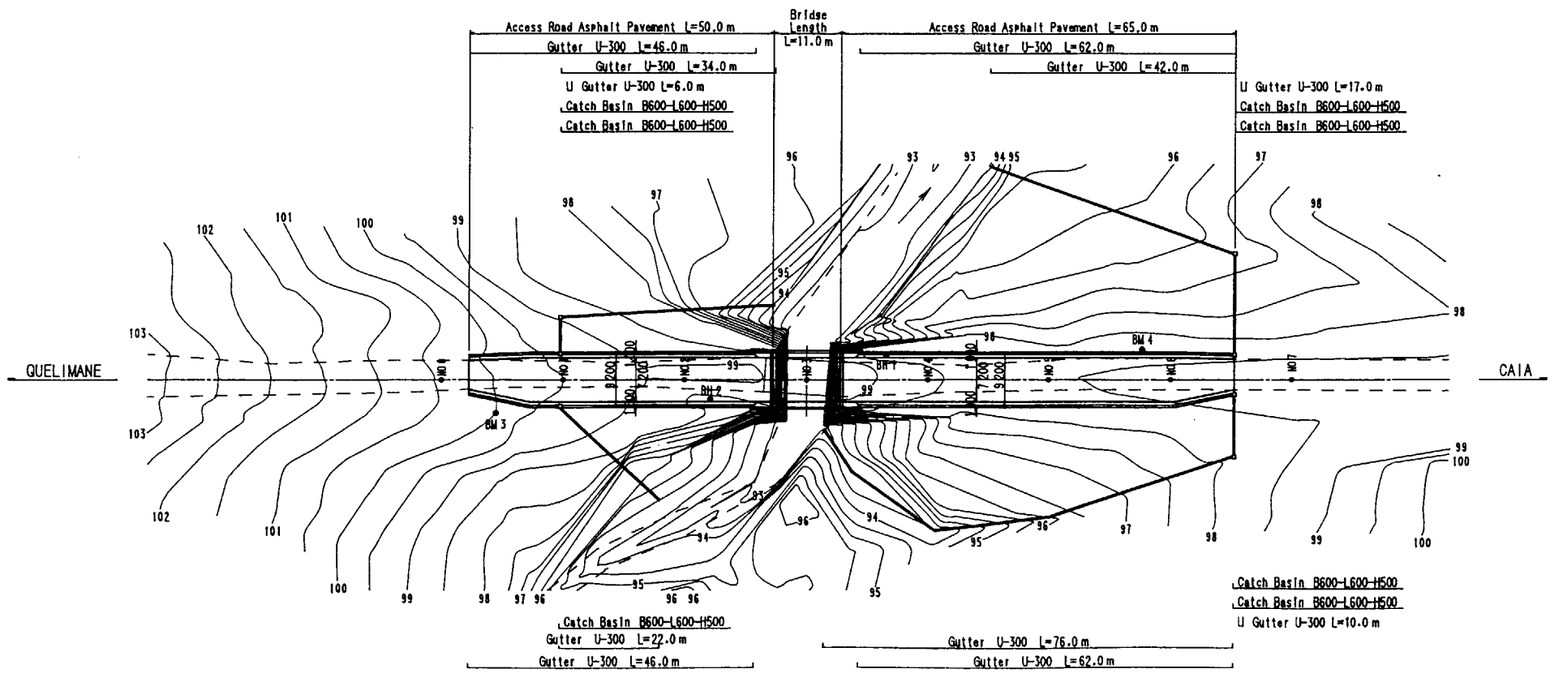
SAMBALENDO BRIDGE



PROFILE



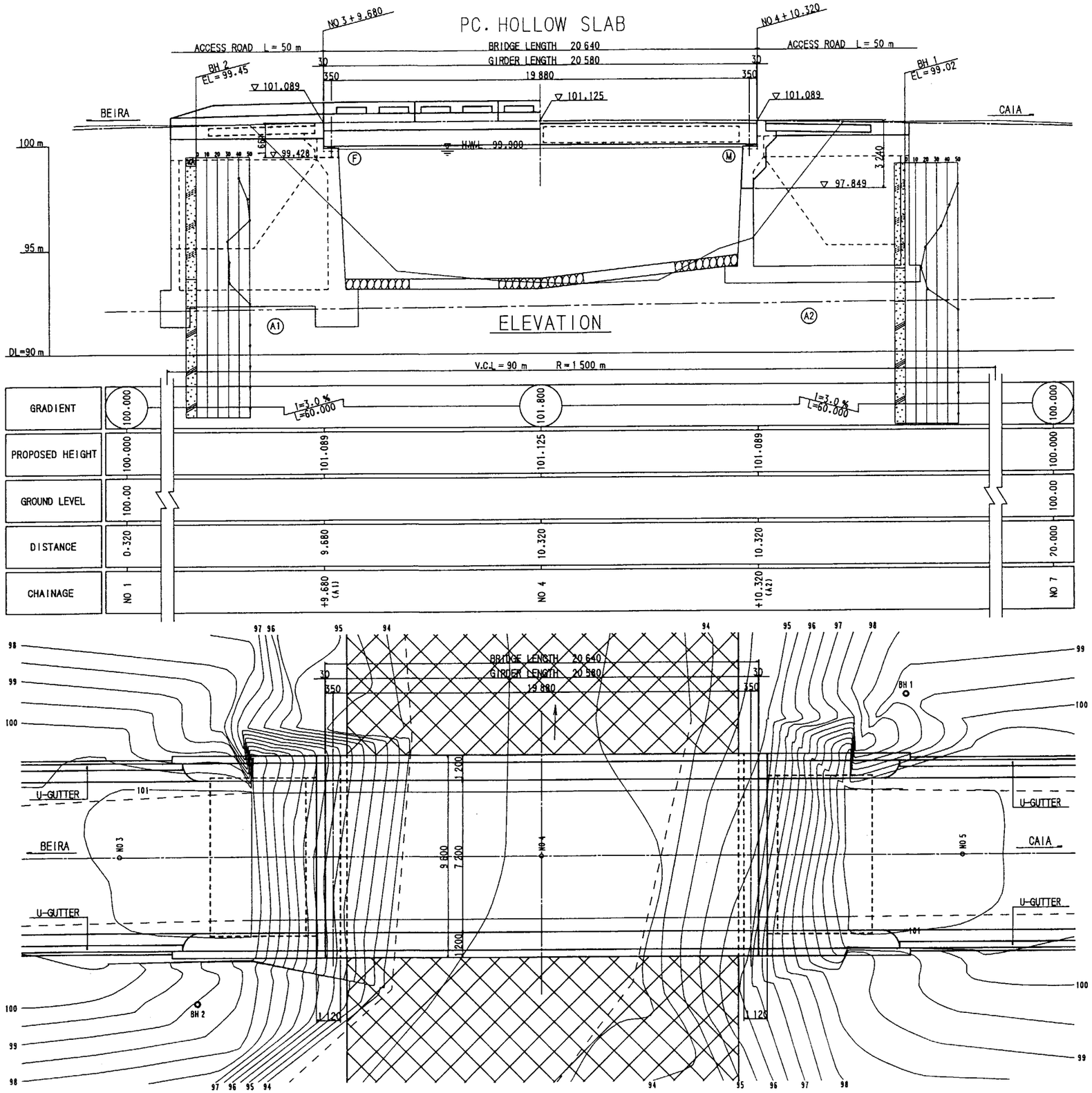
TYPICAL CROSS SECTION S = 1 : 100

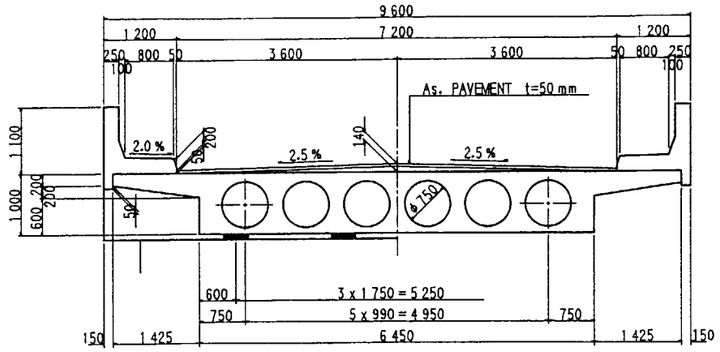


PLAN S = 1 : 500

Fig-2-31 Sambalendo Bridge Access Road

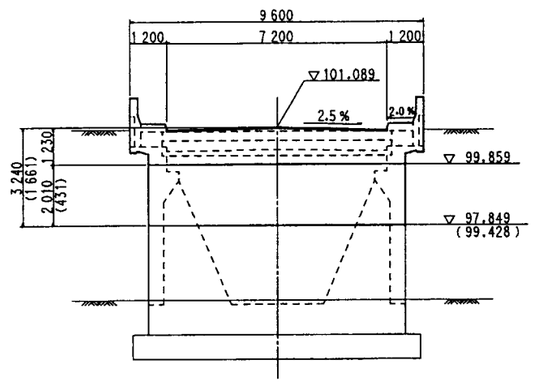
XISADZE II BRIDGE GENERAL ARRANGEMENT S=1:100



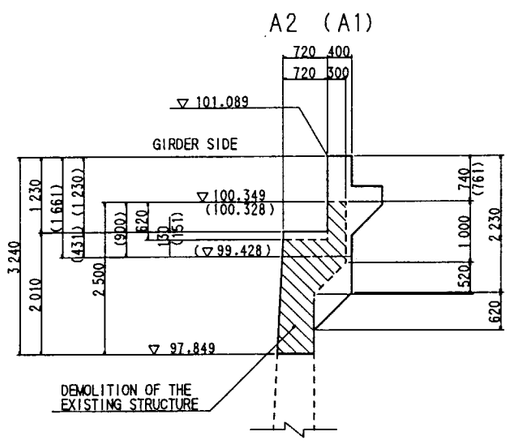


CROSS SECTION S=1:50

ABUTMENT
A2 (A1)



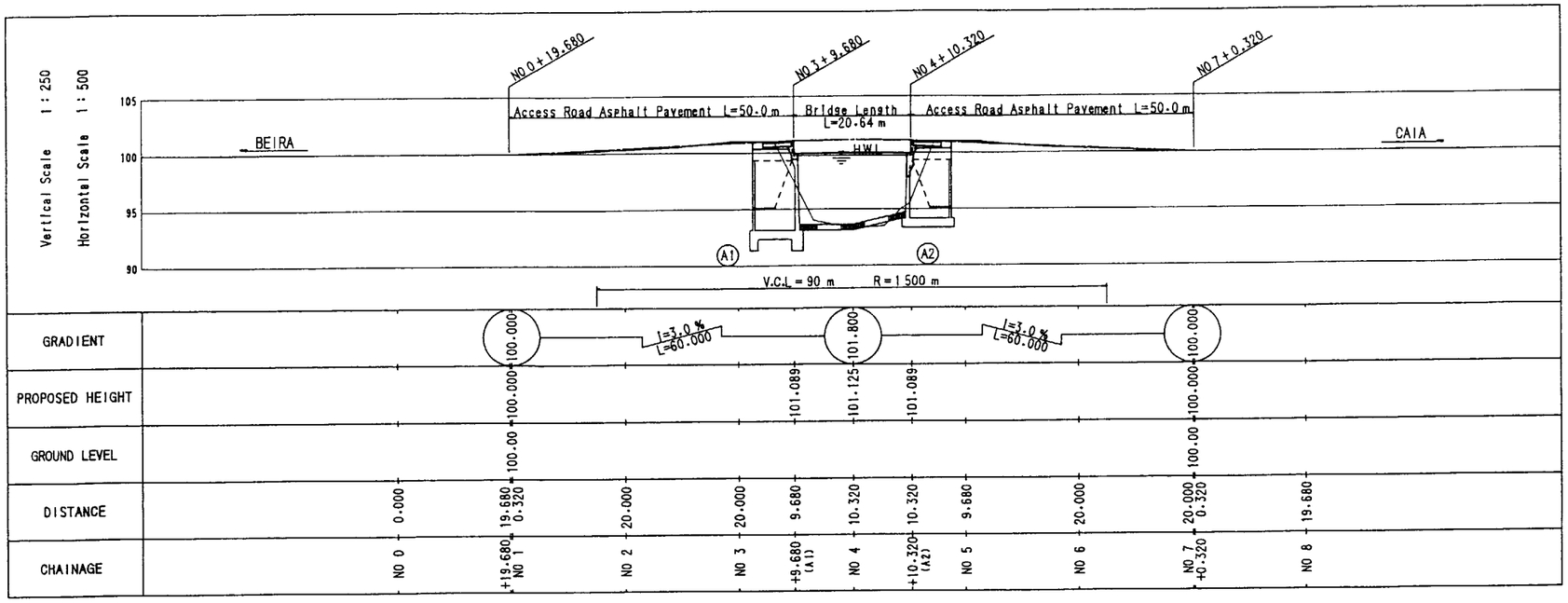
FRONT VIEW



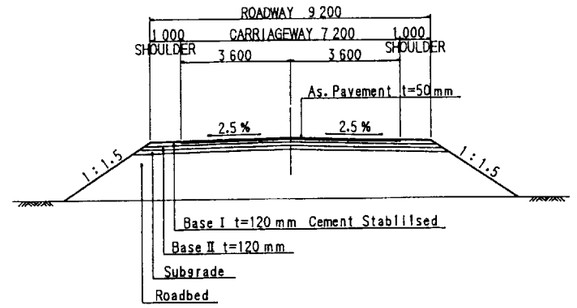
PARAPET WALL S=1:50

Fig-2-32 Xisadze II Bridge

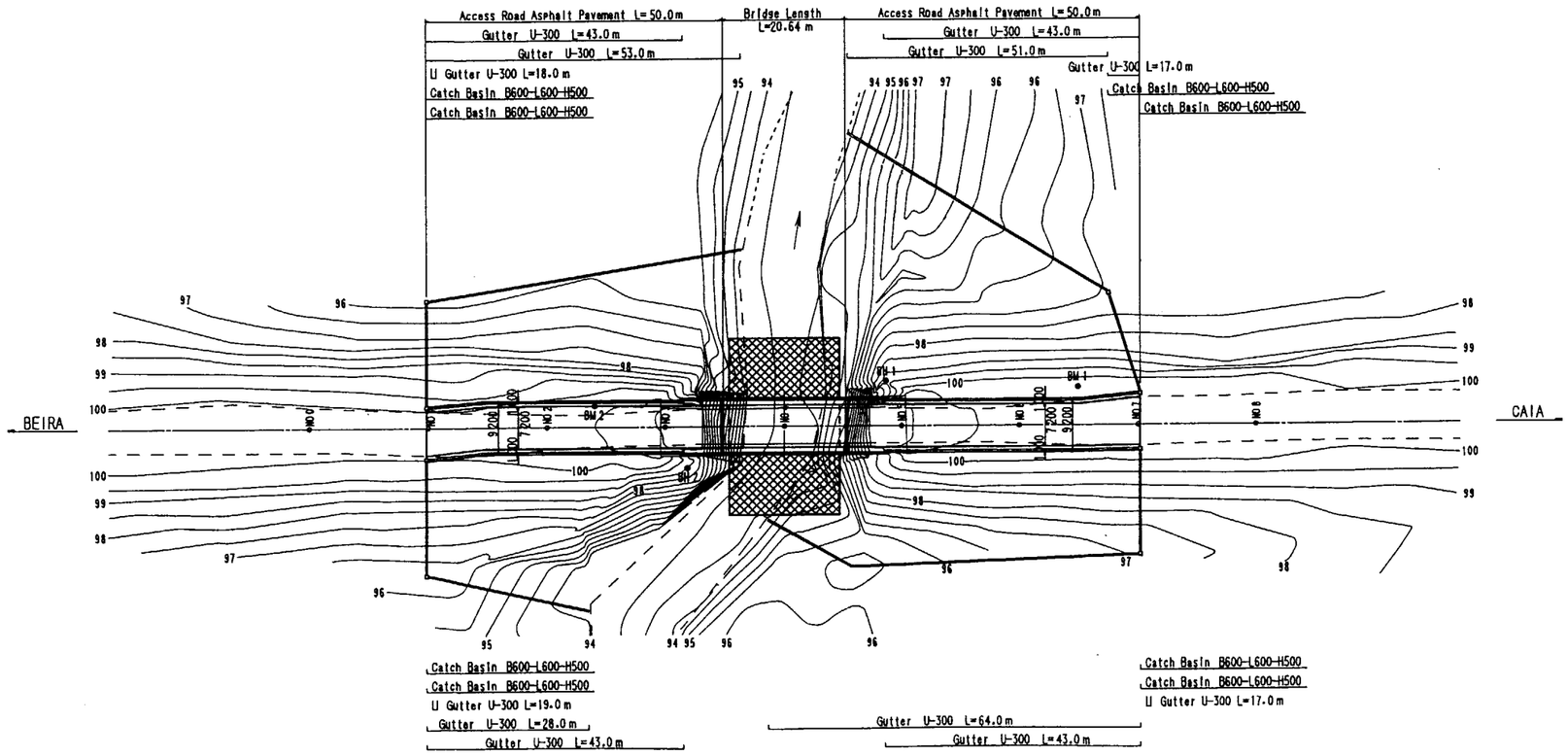
PLAN OF ACCESS ROAD　XISADZE II BRIDGE



PROFILE



TYPICAL CROSS SECTION　S = 1 : 100



PLAN　S = 1 : 500

Fig-3-33 Xisadze II Bridge Access Road

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Concept

(1) Characteristics of the Project

This project supplements "Reconstruction of Bridges on the Main National Roads" which is under construction at the moment and the objective is to reconstruct bridges on the same route as above in principle. The number of bridge is 15 and they are spread over 1,300km of roads. The construction is planned to be carried out in two blocks with two construction teams in each block simultaneously (total four teams) as shown in Table-3-1.

Table-3-1 Construction Plan

Block	Base Camp	Route No.	Bridge Name
1	Cuamba	8	Natete
		8	Niose
		8	Murusso
		8	Namutimbua
		8	Ningare
	Morocue	232	Nicaca
		104	Namilate
2	Quelimane	225	Chinamaze
		225	Munhonha
		225	Bilila
		225	Sinonono
		225	Namihungo
		1	Xisadze II
		225	Sambalendo
		104	Marata

(2) Utilization of Local Consultant

Two resident engineers from Japan will be deployed for construction supervision and some engineers will be employed through a local consultant and provided under them in order to aim effective and smooth execution of supervision. On the Job Training (OJT) to those engineers will be made through daily supervision of construction work.

(3) Dispatch of Japanese Technicians

Mechanical engineers will be deployed from Japan to maintain and look after heavy construction equipment. Carpenters to assemble hollow form in slab concrete will also be deployed from Japan since there is not enough experience to assemble such form in Mozambique. A specialist for pre-stressing work will also be deployed from Japan for Xisadze II bridge of which slab is pre-stressed structure.

3-1-2 Implementation Conditions

(1) Procurement of Materials and Equipment

As prescribed in **2-3-1 Design Concept**, there is a limit for procuring construction materials except sand and aggregate in Mozambique. Sand and aggregate will be procured near from the site as much as possible and the rest of materials shall be imported from neighbor countries like South Africa. Consequently, it is inevitable to avoid delay of construction schedule by confirming a smooth customs clearance, securing transportation routes, confirming required period of transport etc. Confirmation of budgetary allocation of import duty and tax in ANE is the most important factor.

(2) Counter Measure for Rainy Season

Rainfall is mainly concentrated from December to March, and during the period performance of work will be dropped drastically thus special care will be required to program the work.

On the unpaved road like route 8, it is very hard to travel over during the rainy season thus the transportation of materials and equipment shall be concentrated during a dry season and enough area of stock yard shall be provided to store them.

Temporary diversion of road will be provided for reconstruction of bridges at each bridge site therefore, it is important to maintain the same in good and trafficable condition even at the rainy season even.

(3) Mine Clearing

Mine clearing to the project area will be carried out by ANE before hand however, the area does not include temporary yard etc. thus mine clearing work shall be made by Japanese side again prior to the commencement of construction activities in order to ensure the safety operation of work.

The cleared area shall be marked with pegs clearly and prohibited both of construction worker and the third party to enter the outer area.

3-1-3 Scope of Works

(1) Scope of Works of Japanese side

a. Reconstruction of 15 bridges
b. Access roads at each bridge
c. Removal of Bailey Bridge

(2) Scope of Works of Mozambican side

a. Dismantle and transport out of Bailey Bridge from site

3-1-4 Consultant Supervision

(1) Basic Plan

Construction supervision will be performed to the following items.

a. To check the method of statement presented by a contractor,
b. To hold a kick-off meeting among the parties concerned,
c. To inspect the works and give instructions,
d. To check and give approval to construction plans and shop drawings presented by a contractor,
e. To inspect supplied materials,
f. To monitor a work done and issue a certificate,
g. To prepare progress report of the works,
h. To monitor and give an advise to the works performed by the recipient country,
i. To examine completion of the works and issue a completion certificate,
j. To assist of handing over the Project after completion,
k. To prepare a final report after completion of a construction supervision and
l. To carry out inspection work at the end of a defect liability period of one year from the completion.

(2) Conditions

Implementation conditions are as prescribed in **3-1-2 Implementation Condition** and for the construction supervision and the maintenance of temporary road diversion shall be carefully made in order to avoid unnecessary accident and/or traffic congestion.

3-1-5 Procurement Plan

Procurement plan for major construction equipment and materials are as shown in Table-3-2. Local procurement is limited as aggregates and small-scale construction equipment.

Table-3-2 Procurement Plan

	Material and Equipment	Japan	Local	S.Africa	Transportation	Reasons
	Bulldozer		△	○	Sea	△marked equipment are available
	Back Hoe			○	Sea	locally however, these are not for
	Dump Truck		△	○	Sea	hire therefore, most of equipment
	Tractor Shovel			○	Sea	are to be mobilized from South
	Truck Crane			○	Sea	Africa.
	Crawler Crane			○	Sea	
E	Vibration Hammer			○	Sea	
Q	Diesel Hammer			○	Sea	
U	Motor Grader		△	○	Sea	
I	Road Roller			○	Sea	
P	Tire Roller			○	Sea	
M	Vibration Roller			○	Sea	
E	Giant Braker			○	Sea	
N	Concrete Plant		△	○	Sea	
T	Engine Generator			○	Sea	
	Air Compressor			○	Sea	
	Submersible Pump			○	Sea	
	Stress Jack			○	Sea	
	Jack Pump			○	Sea	
	Grout Pump			○	Sea	
	Earth Auger			○	Sea	
	Engine Welder			○	Sea	
	Gravel		○		Land	
	Sand		○		Land	
	Crushed Stone		○		Land	
	Portland Cement			○	Sea	Poor quality and production.
M	Asphalt			○	Sea	Not produced locally.
A	Reinforcing Bar			○	Sea	Not produced locally.
T	PC Wire			○	Sea	Not produced locally.
E	Sheath			○	Sea	Not produced locally.
R	Anchor			○	Sea	Not produced locally.
I	Steel Form			○	Sea	Not produced locally.
A	Steel Support			○	Sea	Not produced locally.
L	Scaffolding			○	Sea	Not produced locally.
	Section Steel	○		○	Sea	Not produced locally.
	Bearing			○	Sea	Not produced locally.
	Expansion Joint			○	Sea	Not produced locally.

3-1-6 Implementation Schedule

Implementation schedule of the Project is as shown in Table-3-2.

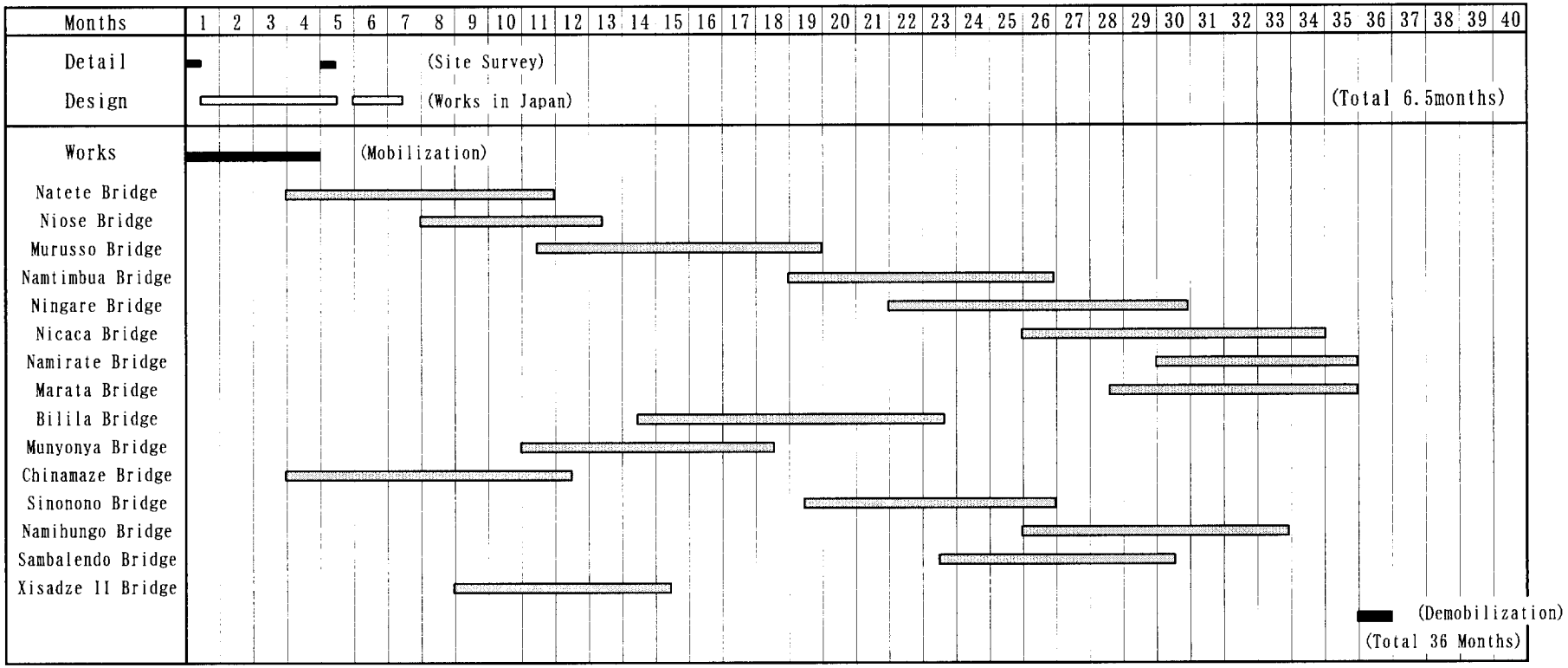
3-1-7 Responsibility of Two Governments

Both government shares the responsibility for the project implementation as shown in table-3-3.

Table-3-3 Responsibility of Each Government

No	Items	To be covered by Grant Aid	To be covered by Recipient
1.	To secure land including detour and camp yard.		●
2.	To clear obstacles including land mines hampered the execution of the Project.		●
3.	To bear the following commission to the Japanese bank for the banking services based upon the B/A.		
	1) Advising commissions of A/P		●
	2) Payment commission		●
4.	To ensure unloading and customs clearance at port of disembarkation in recipient country.		
	1) Marine (Air, Road) transportation of the products from Japan to the recipient country.	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site.	●	
5.	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
6.	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		●
7.	To maintain and use properly and effectively the facilities constructed provided under the Grant.		●
8.	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities.		●
9.	To ensure the safety of all personnel from contractors engaged to the Project.		●

Table-3-2 Implementation Schedule



3-2 Operation and Maintenance Plan

In the project, due to concrete bridge structure, only the periodical check will be the major work, however, the periodical maintenance will be required for expansion joint and pavement etc. No special technical ability is required for the maintenance and Mozambique side is able to carry out the same with no problem.

An annual maintenance cost is estimated at;

1) Repairing	: US$ 22,500
2) Others	: US$ 1,500
Total	: US$ 24,000

An annual budget for roads and bridges maintenance in Mozambique is US$11,000,000 and percentage of the maintenance cost of new bridges is 0.2% of the budget which being the range of allocation.

Chapter 4 Project Evaluation and Recommendations

4-1 Project Effect

For the reconstruction of economy and infrastructures destroyed by prolonged civil war especially for the opening of roads, Mozambique Government has concentrated to reconstruct and improve international trunk road such as Maputo corridor, Beira corridor and Nakara corridor and also North-South link starting from Maputo through ROCS plan.

This project supplements for reconstruction of 13 bridges currently carried out under "The Project for Reconstruction of Bridges on the Main National Road" financed by the Japanese grant aid. And the execution of the project will contribute to economic development not only of the country but also of Southern African countries by eliminating bottleneck of road transport on Nakara corridor and North- South link and will be promoting commodity and human flow due to smooth traffic and increase of road transport.

The beneficiary of the project is ordinary citizens including poor people and the number of beneficiary will reach more than 70% of citizens since the objective roads are running through from north to south on the coastal provinces where population is high. The aim of the project is to promote economic development by resettling of refugees during the civil war which is counted at 1.5 million, stabilizing human life and improving of local inhabitants' living standard urgently.

Implementing agency of the project in Mozambique is ANE and as prescribed, he is able to maintain and operate constructed bridges without any problem.

The project is conforming a part of ROCS plan and ROADS plan from year 2000 and will contribute enough for the achievement of the aim to improve road and bridge in Mozambique.

It is assumed that there is a less impact to the environmental effect of each bridge site since there is no formation of big scale village and there is no sign of wild animal's inhabitation around each bridge. Only the contamination of the water by mud during the construction time may be happened.

4-2 Recommendations

It is concluded that the implementation of the project is meaningful since, as prescribed, a great effect and contribution for basic human needs of local inhabitants is widely expected. It can be said that, by the implementation of ROCS plan and ROADS plan, the improvement of main national road net work which was unpaved or impassable will substantially be solved.

However as regard to Nakara corridor, route 8, which is connecting Malawi and Nakara port facing the Indian Ocean, road improvement by asphaltic paving is necessary to be implemented as early as possible in order to exhibit the project effect more.

Concerning to mine clearance, the project area will be cleared by ANE beforehand however, double check shall be made by Japanese side in order to ensure safety operation of work. The cleared area shall be marked and make prohibit both of construction worker and the third party to enter outer area to avoid any accident caused by mine.

1. Member List of the Study Team

(1) The First Visit to Mozambique (1999/5/27~6/6)

Position	Name	Belonging
Team Leader	Mr. Yasuo Mukai	JICA
Grant Aid Div.	Mr. Kenichiro Kobayashi	The 2nd Div., Grant Aid Study Dept. JICA
Chief Consultant Road/Transport	Mr. Masayoshi Komagamine	Chodai Co., Ltd.
Bridge Designer I	Mr. Junji Yasui	Chodai Co., Ltd.
Bridge Designer II	Mr. Masahiko Mori	Chodai Co., Ltd.

(2) The Second Visit to Mozambique (1999/6/30~8/8)

Position	Name	Belonging
Team Leader	Mr. Atsumu Iwai	The 3rd Group, Grant Aid Dept. JICA
Chief Consultant Road/Transport	Mr. Masayoshi Komagamine	Chodai Co., Ltd.
Bridge Designer I	Mr. Junji Yasui	Chodai Co., Ltd.
Bridge Designer II	Mr. Masahiko Mori	Chodai Co., Ltd.
Investigator I	Mr. Isamu Suzuki	Nippon Koei Co., Ltd.
Investigator II	Mr. Sigeaki Hisajima	Nippon Koei Co., Ltd.
Construction Plan	Mr. Jun Morishita	Chodai Co., Ltd.
Interpreter	Ms. Saho Toda	Chodai Co., Ltd.

(3) The Third Visit to Mozambique (1999/10/20~10/31)

Position	Name	Belonging
Team Leader	Mr. Shinji Obuchi	Tokyo International Training Center, JICA
Chief Consultant Road/Transport	Mr. Masayoshi Komagamine	Chodai Co., Ltd.
Bridge Designer I	Mr. Junji Yasui	Chodai Co., Ltd.
Bridge Designer II	Mr. Masahiko Mori	Chodai Co., Ltd.

2. Itinerary

(1) Officials

1) The First Visit to Mozambique

Mr. T. Mukai, Mr. K.Kobayashi

Date	Movement	Accommodation	Activities
May 28(Fri)	Arrive to Maputo		Courtesy call on DNEP
	Maputo to Beira	Beira	
May29(Sat)	Beira to Quelimane	Quelimane	Site survey (Fishery Port)
May30(Sun)		Quelimane	Site survey (Sinonono, Namihungo and Sambarendo)
May31(Mon)	Quelimane to Maputo	Maputo	Courtesy call on DNEP Quelimane
Jun 1(Tue)		Mapoto	Discussion with DNEP
Jun 2(Wed)		Maputo	Courtesy call on MOPH and MOFAC
Jun 3(Thr)		Maputo	Signing of Minutes of Discussion
Jun 4(Fri)		Johannesburg	Reporting to Embassy of Japan and JICA
Jun 5(Sat)	Leave Johannesburg		

2) The Second Visit to Mozambique

Mr. A. Iwai

Date	Movement	Accommodation	Activities
Jul 1(thr)	Arrive to Maputo	Maputo	Courtesy call on DNEP
Jul 2 (fri)		Maputo	Explanation of Interim Report and discussion of the project. Team meeting
Jul 3 (sat)		Maputo	Site survey (Nicaca)
Jul 4 (sun)	Maputo to Nampla (Air)	Nampula	Site survey (Niose and Natete)
Jul 5 (mon)		Nampula	
Jul 6 (tue)	Nampula to Maputo (Air)	Maputo	Discussion of the project. Courtesy call on Ministry of Public Works and Housing and Ministry of Foreign Affairs and Cooperation.
Jul 7 (wed)		Maputo	Signing of Minutes of Meeting
Jul 8 (thr)		Maputo	Reporting to the Embassy of Japan and JICA
Jul 9 (fri)	Maputo to Johannesburg	Johannesburg	
Jul 10 (sat)	Leave Johannesburg		

3) The Third Visit to Mozambique

Mr. S. Obuchi

Date	Movement	Accommodation	Activities
Oct 21 (thr)	Arrive to Maputo	Maputo	Courtesy call on ANE, hand over Draft Final Report
Oct 22 (fri)		Maputo	Explanation of Draft Final Report
Oct 23 (sat)	Maputo to Nampula	Nampula	Site Survey (Nicaca)
Oct 24 (sun)		Nampula	Site Survey (Natete and Nioce)
Oct 25 (mon)	Nampula to Maputo	Maputo	
Oct 26 (tue)		Maputo	Discussion with ANE
Oct 27 (wed)		Maputo	Signing of Minutes of Discussion
Oct 28 (thr)	Maputo to Johannesburg	Johannesburg	
Oct 29 (fri)		Johannesburg	Reporting to Embassy of Japan and JICA
Oct 30 (sat)	Leave Johannesburg		

(2) Consultants

1) The First Visit to Mozambique

Study Team 1 (Mr. J. Yasui)

Date	Movement	Accommodation	Activities
May23(Sun)	Arrive to Maputo	Maputo	
May24(Mon)		Maputo	Courtesy call on DNEP
May25(Tue)		Maputo	Discussion with DNEP
May26(Wed)		Maputo	Discussion with DNEP
May27(Thr)	Maputo to Beira	Beira	
May28(Fri)		Beira	Site survey (Guenjere)
May29(Sat)	Beira to Quelimane	Quelimane	Site survey (Fishery Port)
May30(Sun)		Quelimane	Site survey (Sinonono, Namihungo and Sambarendo)
May31(Mon)	Quelimane to Maputo	Maputo	Courtesy call on DNEP Quelimane
Jun 1(Tue)		Mapoto	Discussion with DNEP
Jun 2(Wed)		Maputo	Courtesy call on MOPH and MOFAC
Jun 3(Thr)		Maputo	Signing of Minutes of Discussion
Jun 4(Fri)		Johannesburg	Reporting to Embassy of Japan and JICA
Jun 5(Sat)	Leave Johannesburg		

Study Team 2 (Mr. M. Komagamine and Mr. M. Mori)

Date	Movement	Accomodatio	Activities
May23(Sun)	Arrive to Maputo	Maputo	
May24(Mon)		Maputo	Courtesy call on DNEP
May25(Tue)	Maputo to Nampula	Nampula	
May26(Wed)	Nampula to Cuamba	Cuamba	Site survey (Natete, Niose and Mitacatine)
May27(Thr)		Cuamba	Site survey (Ningare, Namthimbua)
May28(Fri)		Nampula	Site survey (Murusso)
May29(Sat)	Nampula to Mocuba	Mocuba	Site survey (Nicaca)
May30(Sun)	Mocuba to Quelimane	Quelimane	Site survey (Marata and Namilate)
May31(Mon)		Quelimane	Courtesy call on DNEP Quelimne and site survey (Bilila)
Jun 1(Tue)		Quelimane	Site survey (Munhonha, Chinamaze and Xisadze II)
Jun 2(Wed)	Quelimane to Maputo	Maputo	
Jun 3(Thr)		Maputo	Signing of Minutes of Discussion
Jun 4(Fri)		Johannesburg	Reporting to Embassy of Japan and JICA
Jun 5(Sat)	Leave Johannesburg		

2) The Second Visit to Mozambique

Study Team – 1 (Mr. M.Komagamine)

Date	Movement	Accommodation	Activities
Jul 1(thr)	Arrive to Maputo	Maputo	Courtesy call on DNEP
Jul 2 (fri)		Maputo	Courtesy call on the Ministry of Works and Housing and DNEP.
Jul 3 (sat)		Maputo	Team meeting
Jul 4 (sun)	Maputo to Nampla (Air)	Nampula	
Jul 5 (mon)		Nampula	Site survey (Niose and Natete)
Jul 6 (tue)	Nampula to Maputo (Air)	Maputo	
Jul 7 (wed)		Maputo	Explanation of Interim Report and discussion of the project.
Jul 8 (thr)		Maputo	Signing of Minutes of Meeting
Jul 9 (fri)	Maputo to Johannesburg	Johannesburg	Reporting to the Embassy of Japan and JICA
Jul 10 (sat)	Johannasburg to Maputo	Maputo	
Jul 11 (sun)		Maputo	Reporting
Jul 12 (mon)	Maputo to Quelimane (Air)	Quelimane	
Jul 13 (tue)	Quelimane to Chinamaze	Quelimane	Site survey (Bilila, Munhonha and Chinamaze)
Jul 14 (wed)	Quelimane to Sambalendo	Quelimane	Site survey (Sinonono, Nhamingulo and Sambalendo)
Jul 15 (thr)	Quelimane to Xisaze II	Quelimane	Site survey (Xisaze II)
Jul 16 (fri)		Quelimane	Reporting
Jul 17 (sat)		Quelimane	Reporting
Jul 18 (sun)	Quelimane to Mocuba	Mocuba	Site survey (Marata and Namilate)
Jul 19 (mon)	Mocuba to Nampula	Nampula	Site survey(Nicaca)
Jul 20 (tue)		Nampula	Reporting
Jul 21 (wed)		Nampula	Reporting
Jul 22 (thr)	Nampula to Cuamba	Cuamba	
Jul 23 (fri)	Cuamba to Lurio	Cuamba	Site survey(Ningare, Namutimbua and Murusso)
Jul 24 (sat)	Cuamba to Nampula	Nampula	Site survey (Niose and Natete)
Jul 25 (sun)		Nampula	Reporting
Jul 26 (mon)	Nampula to Maputo (Air)	Maputo	Reporting
Jul 27 (tue)		Maputo	Reporting
Jul 28 (wed)		Maputo	Reporting
Jul 29 (thr)		Maputo	Reporting
Jul 30 (fri)		Maputo	Reporting
Jul 31 (sat)		Maputo	Reporting
Aug 1 (sun)		Maputo	Reporting
Aug 2 (mon)		Maputo	Reporting
Aug 3 (tue)		Maputo	Discussion with DNEP
Aug 4 (wed)	Maputo to Johannesburg	Johannesburg	
Aug 5 (thr)		Johannesburg	Reporting to the Embassy of Japan and JICA
Aug 6 (fri)		Johannesburg	Data collection
Aug 7 (sat)	Leave Johannesburg		

Study Team – 1 (S.Hisajima)

Date	Movement	Accommodation	Activities
Jul 1(thr)	Arrive to Maputo	Maputo	Courtesy call on DNEP
Jul 2 (fri)		Maputo	Courtesy call on the Ministry of Works and Housing and DNEP.
Jul 3 (sat)		Maputo	Team meeting
Jul 4 (sun)		Maputo	Data collection
Jul 5 (mon)		Maputo	Data collection
Jul 6 (tue)		Maputo	Data collection
Jul 7 (wed)		Maputo	Explanation of Interim Report and discussion of the project.
Jul 8 (thr)		Maputo	Signing of Minutes of Meeting
Jul 9 (fri)		Maputo	Reporting
Jul 10 (sat)		Maputo	Reporting
Jul 11 (sun)		Maputo	Reporting
Jul 12 (mon) ~	The same as Mr. M. Komagamine		

Study Team – 2 (Mr. J. Yasui, M. Mori and I. Suzuki)

Date	Movement	Accommodation	Activities
Jul 1 (thr)	Arrive to Maputo	Maputo	Courtesy call on DNEP
Jul 2 (fri)		Maputo	Courtesy call on the Ministry of Works and Housing and DNEP.
Jul 3 (sat)		Maputo	Team meeting
Jul 4 (sun)		Maputo	Data collection
Jul 5 (mon)	Maputo to Nampula (Air)	Nampula	
Jul 6 (tue)	Nampula to Malema	Malema	Site survey (Natete)
Jul 7 (wed)	Malema to Cuamba	Cuamba	Site survey(Niose)
Jul 8 (thr)	Cuamba	Cuamba	Site survey(Ningare and Namtimbua)
Jul 9 (fri)	Cuamba to Nampula	Nampula	Site survey((Murusso)
Jul 10 (sat)		Nampula	Data collection
Jul 11 (sun)		Nampula	Reporting
Jul 12 (mon)		Nampula	Reporting
Jul 13 (tue)	Nampula to Nicaca	Nampula	Site survey(Nicaca)
Jul 14 (wed)	Nampula to Mocuba	Mocuba	
Jul 15 (thr)	Mocuba to Namirate	Mocuba	Site survey(Namilate and Marata)
Jul 16 (fri)	Mocuba to Quelimane	Quelimane	
Jul 17 (sat)		Quelimane	Reporting
Jul 18 (sun)		Quelimane	Reporting
Jul 19 (mon)		Quelimane	Reporting
Jul 20 (tue)	Quelimane to Munhonha	Quelimane	Site survey(Bilila and Munhonha)
Jul 21 (wed)	Qulimane to Sinonono	Quelimane	Site survey(Chinamaze and Sinonono)
Jul 22 (thr)	Quelimane to Nahmingulo	Quelimane	Site survey(Nahmingulo)
Jul 23 (fri)	Quelimane to Sambalendo	Quelimane	Site survey(Sambalendo)
Jul 24 (sat)	Quelimane to Zangue	Zangue	Site survey(Xisadze II)
Jul 25 (sun)	Zangue to Quelimane	Quelimane	
Jul 26 (mon)		Quelimane	Data collection
Jul 27 (tue)		Quelimane	Reporting
Jul 28 (wed)	Quelimane to Maputo (Air)	Maputo	Reporting
Jul 29 (thr)		Maputo	Reporting
Jul 30 (fri)		Maputo	Reporting
Jul 31 (sat)		Maputo	Reporting
Aug 1 (sun)		Maputo	Reporting
Aug 2 (mon)		Maputo	Reporting
Aug 3 (tue)		Maputo	Discussion with DNEP
Aug 4 (wed)		Maputo	Reporting
Aug 5 (thr)	Maputo to Johannesburg	Johannesburg	
Aug 6 (fri)		Johannesburg	Data collection
Aug 7 (sat)	Leave Johannesburg		

Study Team – 2 (Mr. J.Morisita)

Date	Movement	Accommodation	Activities
~ Jul 31(sat)	The same as Mr. M.Mori and others.		
Aug 1 (sun)	Maputo to Johannesburg	Johannesburg	
Aug 2 (mon)		Johannesburg	Data collection
Aug 3 (tue)		Johannesburg	Data collection
Aug 4 (wed)		Johannesburg	Data collection
Aug 5 (thr)		Johannesburg	Data collection
Aug 6 (fri)		Johannesburg	Data collection
Aug 7 (sat)	Leave Johannesburg		

Study Team – 3 (Ms. S. Toda)

Date	Movement	Accomodation	Activities
Jul 1(thr)	Arrive to Maputo	Maputo	Courtesy call on DNEP
Jul 2 (fri)		Maputo	Courtesy call on the Ministry of Works and Housing and DNEP.
Jul 3 (sat)		Maputo	Team meeting
Jul 4 (sun)		Maputo	Data collection
Jul 5 (mon)		Maputo	Data collection
Jul 6 (tue)		Maputo	Data collection
Jul 7 (wed)		Maputo	Explanation of Interim Report and discussion of the project.
Jul 8 (thr)		Maputo	Signing of Minutes of Meeting
Jul 9 (fri)		Maputo	Reporting
Jul 10 (sat)		Maputo	Reporting
Jul 11 (sun)	Maputo to Nampula (Air)	Nampula	
Jul 12 (mon)	Nampula to Quelimane	Quelimane	
Jul 13 (tue)		Quelimane	Reporting
~27 (tue)		Quelimane	Reporting
Jul 28 (wed)	Quelimane to Maputo	Maputo	
Jul 29 (thr)		Maputo	Reporting
Jul 30 (fri)		Maputo	Reporting
Jul 31 (sat)		Maputo	Reporting
Aug 1 (sun)		Maputo	Reporting
Aug 2 (mon)		Maputo	Reporting
Aug 3 (tue)		Maputo	Reporting
Aug 4 (wed)		Maputo	Discussion with DNEP
Aug 5 (thr)	Maputo to Johannesburg	Johannesburg	Reporting
Aug 6 (fri)		Johannesburg	Data collection
Aug 7 (sat)	Leave Johannesburg		

3) The Third Visit to Mozambique

Mr. M.Komagamine, Mr. J.Yasui, Mr. M.Mori

Date	Movement	Accomodation	Activities
Oct 21 (Thu)	Arrive to Maputo	Maputo	Courtesy call on ANE
Oct 22 (Fri)		Maputo	Explanation of Draft Final Report Courtesy call on MOFAC
Oct 23 (Sat)		Nampula /Maputo	Official and Mori – Site investigation (Nicaca) Discussion with ANE
Oct 24 (Sun)		Nampula/Maputo	Official and Mori – Site investigation (Natete, Nioce)
Oct25 (Mon)		Maputo	Discussion with ANE Official and Mori – Back to Maputo
Oct26 (Tue)		Maputo	Discussion with ANE
Oct27 (Wed)		Maputo	Signing of Minutes of Discussion
Oct28 (Thu)	Maputo to Johannesburg	Johannesburg	
Oct29 (Fri)		Johannesburg	Reporting to the Embassy of Japan and JICA
Oct30 (Sat)	Leave Johannesburg		

3. List of Personnel in the Recipient Country

MOPH	: Mr. R. White	Minister
ANE	: Mr. C. Fragoso	Chairman
	Mr. A. Mungunhe	Acting on Behalf of Chairman
	Mr. T. Massinguhe	Head of Project and Studies Dept.
	Mr. A. V. Notece	Civil Engineer
	Mr. E. R. Mussupai	Civil Engineer
	Mr. M. Lear	Technical Assistant (SWEROAD)
MOFAC	: Mr. A. Z. Kuepela	Division Director for Asia and Oceania
	Mr. A. Jamo	Deputy Division Director for Asia and Oceania
	Mr. C. V. Mortar	Desk Officer for Japan
	Mr. K. Oyama	JICA Expert
AFROVITA	: Ms. L. A. Cuna	Vice President
	Mr. C. Stein	General Manager

MOPH : Ministry of Public Works and Housing
ANE : National Road Administration
MOFAC : Ministry of Foreign Affairs and Cooperation

4. Minutes of Discussions

Minutes of Discussions on the Basic Design Study on the Project for the Reconstruction of Bridges on the Main National Roads II in the Republic of Mozambique

(First Field Study)

In response to a request from the Government of the Republic of Mozambique (hereinafter referred to as "the Mozambique"), the Government of Japan decided to conduct a Basic Design Study on the Project for Reconstruction of Bridges on the Main National Roads II (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Republic of Mozambique the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Yasuo Mukai, JICA, and is scheduled to stay in the country from May 23 to June 4, 1999.

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

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the Interim Report.

Maputo, Jun. 3, 1999

Mr. Yasuo Mukai
Leader
Basic Design Study Team
Japan International Cooperation Agency
Japan

Mr. Carlos Fragoso
National Director
National Directorate of
Roads and Bridges
Ministry of Public Works
and Housing
Republic of Mozambique

ATTACHMENT

1. OBJECTIVE OF THE PROJECT

The objective of the Project is to construct permanent bridges to replace old bridges, which have deteriorated due to war, severe weather and age, and are hindering the safe transportation in the Project areas. Improvement and reconstruction of the roads and bridges are the key factors that shall help execution of National Reconstruction Program of the Mozambique Government. By constructing the new bridges, all weather access will be provided to ensure basic transport facilities in the Project area, and to relieve the communities from suffering their daily life. And in the long-term view, socio-economic activities will be encouraged hence to contribute to the development of the Project area.

2. PROJECT SITES

The proposed sites which are subject to the first field survey of the Project are shown in Annex-1.

3. RESPONSIBLE AND IMPLEMENTING AGENCY

3-1. The Responsible Agency is Ministry of Public Works and Housing.

3-2. The Implementing Agency is National Directorate of Roads and Bridges.

4. ITEMS REQUESTED BY THE GOVERNMENT OF MOZAMBIQUE

As a result of the series of discussions, the bridges listed in Annex-2 are requested for the first field study by the Mozambican side. However, the site where risk of the safety is foreseen will be neglected from the list. The final components of the Project will be decided after further studies.

5. CRITERIA FOR THE SELECTION AND PRIORITIZATION OF BRIDGES

The criteria for the selection and prioritization of bridges subject to the second field study are as shown in Annex-3.

6. JAPAN'S GRANT AID SCHEME

6-1. The Mozambican side has understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex-4.

6-2. The Mozambican side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

7. SAFETY MEASURE

The Mozambican side will take all possible measures to secure the safety of the team during the field survey.

8. SCHEDULE OF THE STUDY

8-1. JICA will prepare an Interim Report in English and dispatch a mission in the beginning of July 1999 in order to explain and confirm the contents, then proceed the second field study.

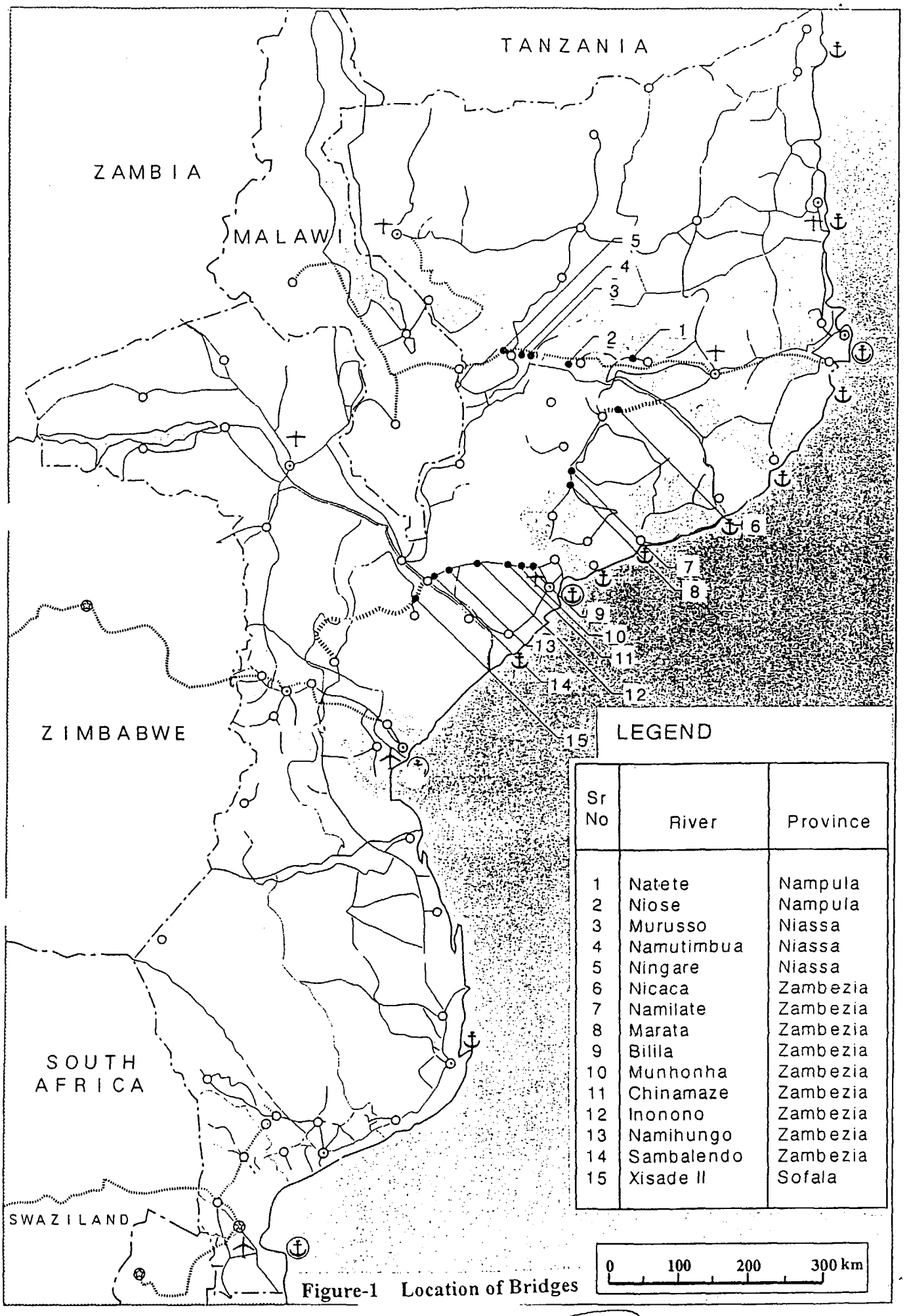
8-2. JICA will prepare a Draft Report in English and dispatch a mission in the end of October 1999 in order to explain and confirm the contents.

8-3. In case that the content of the report is accepted in principle by the Mozambican side, JICA will complete the Final Report and send it to the Mozambican side by January 2000.

9. OTHER RELEVANT ISSUES

9-1. Demining at the bridges that are requested by the government of Mozambique will be implemented by Mozambican side before beginning at the second field study.

9-2. Mozambican side assure that custom clearance problems shall be handled properly by Mozambican side.



Sr No	River	Province
1	Natete	Nampula
2	Niose	Nampula
3	Murusso	Niassa
4	Namutimbua	Niassa
5	Ningare	Niassa
6	Nicaca	Zambezia
7	Namilate	Zambezia
8	Marata	Zambezia
9	Bilila	Zambezia
10	Munhonha	Zambezia
11	Chinamaze	Zambezia
12	Inonono	Zambezia
13	Namihungo	Zambezia
14	Sambalendo	Zambezia
15	Xisade II	Sofala

Figure-1 Location of Bridges

Annex-2

List of Bridges for the first field study being requested by the Government of Mozambique

Sr. No.	Rd. No.	River	Province	Note
1	8	Natete	Nampula	Bailey Bridge
2	8	Niose	Nampula	Concrete
3	8	Murusso	Niassa	Bailey Bridge
4	8	Namutimbua	Niassa	Bailey Bridge
5	8	Ningare	Niassa	Bailey Bridge
6	232	Nicaca	Zambezia	No Bridge
7	104	Namilate	Zambezia	Bailey Bridge
8	104	Marata	Zambezia	Bailey Bridge
9	225	Bilila	Zambezia	Bailey Bridge
10	225	Munhonha	Zambezia	Bailey Bridge
11	225	Chinamaze	Zambezia	Bailey Bridge
12	225	Inonono	Zambezia	Bailey Bridge
13	225	Namihungo	Zambezia	Bailey Bridge
14	225	Sambalendo	Zambezia	Bailey Bridge
15	213	Xisade II	Sofala	Bailey Bridge
Number of Bridges to be investigated				15

The Bridges which will be investigated in detail in the second field study will be selected from the bridge listed above.

Criteria for selection and prioritization of bridges for Basic Design

(1) Prioritization criteria of roads

1) Road development policy of Mozambique Government

1-Five Year Development plan
2-ROCS I, ROCS II and ROCS III Plan (Post War Recovery Project)
3-Strategy and Priority of the Development on National Highway (Grade of the National Highway)

2) Socio Economic Factor

(Industrial and Agricultural Production, Population etc.)

3) Average Daily Traffic Volume

(Present and Future traffic Demand if any)

4) Social Redevelopment plan of the Mozambique Government

1. Resettlement Area for Returnee
2. Industrial and Agricultural Redevelopment Plan

(2) Prioritization criteria for bridges

1) Type of bridge

2) Bridge opening

3) Deterioration rate

4) Bridge width

5) Substructure condition

Japanese Grant Aid Program

(1) Grant Aid Procedure

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Government of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

(2) Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study") conducted by JICA on a requested project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the project by the Japanese Government. The contents of the Study are as follows:

a) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.

c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.

d) Preparation of a basic design of the Project.

e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the study, JICA uses (a) registered consultant firm(s). JICA select (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out the Basic Design Study and write(s) a report, based upon terms of reference set by JICA.
The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

(3) Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

3) "The period of the Grant Aid" means the one fiscal year, which the Cabinet approves, the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.
However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.

b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.

c) To secure buildings prior to the procurement in case the installation of the equipment.

d) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

f) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

g) "Proper Use"
The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

h) "Re-export"
The products purchased under the Grant Aid should not be re-exported from the recipient country.

i) Banking Arrangements (B/A)

- The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

- The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Necessary Measures to be Taken by the Mozambican Side

Following necessary measures should be taken by the Mozambican side on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To assure the safety of the project implementation.

2. To provide data and information necessary for the Project.

3. To secure the land necessary for the execution of the Project, such as the Right of Way, land for the bridge, access roads, temporary camp yards, working area and others.

4. To clear the sites prior to the commencement of the construction including the area where land mine are embedded.

5. To make passable all roads and bridges leading to the Project site before the commencement of inland transportation of materials and equipment.

6. To demolish, if necessary, existing bridges according to the construction schedule which will be provided in the later stage.

7. To obtain permit to use satellite communication system.

8. To bear commissions to the Japanese bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.

9. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in each country and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.

10. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

11. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the Verified Contracts, such facilities as may be necessary for their entry into both countries and stay therein for the performance of their work.

12. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.

13. To maintain and use properly and effectively the facilities constructed under the Project.

14. To coordinate and solve any issues related to the Project, which may be raised by third parties or inhabitants in the Project area during the implementation of the Project.

Minutes of Discussions
on
the Basic Design Study
on
the Project for Reconstruction of Bridges on the Main National Roads II
in
the Republic of Mozambique
(Second Field Survey)

In May 1999, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study team on the Project for Reconstruction of Bridges on the Main National Roads II (hereinafter referred to as "the Project") , to the Republic of Mozambique. Based on the discussions and field survey in Mozambique, and technical examination of the results in Japan, JICA has prepared the Interim Report on the study.

In order to explain and to consult the Government of Mozambique on the components of the Interim Report and conduct the additional field survey, JICA sent to Mozambique a study team (hereinafter referred to as "the Team"), which is headed by Mr. Atsumu Iwai, Third Project Management Division, Grant Aid Management Department, JICA. The Team is scheduled to stay in Mozambique from July 1 to August 5.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets.

Maputo, July 8, 1999

Mr. Atsumu Iwai
Leader
Basic Design Study Team
Japan International Cooperation Agency
Japan

Mr. Carlos Fragoso
National Director of
Roads and Bridges
Ministry of Public Works
and Housing
Republic of Mozambique

ATTACHMENT

1. COMPONENTS OF THE INTERIM REPORT

The Mozambican side has agreed and accepted in principle the components of the Interim Report proposed by the Team. However, the final component of the Project will be decided after further studies.

2.ITEMS REQUESTED BY THE GOVERNMENT OF MOZAMBIQUE

The bridges requested for the second field survey by the Mozambican side are listed in Annex-1. The proposed sites which are subject to the second field survey of the Project are as shown in Annex-2.

3. JAPAN'S GRANT AID SCHEME

The Mozambican side understands the Japan's Grant Aid Scheme and necessary measures to be taken by the Government of Mozambique as explained by the Team and described in Annex-4 and Annex-5 of the Minutes of Discussions signed by both parties on June 3, 1999.

4.FURTHER SCHEDULE OF THE STUDY

(1)The team will proceed to further studies in the Republic of Mozambique until August 5, 1999.

(2)Based on the results of the Second Field Survey, JICA will prepare the Draft Basic Design Study Report in English and dispatch a team in October, 1999 in order to explain and confirm the contents.

(3)In case that the contents of the report is accepted in principle by the Government of Mozambique, JICA will complete the Basic Design Study Report and forward it to the Mozambican side by January 2000.

5.OTHER RELEVANT ISSUES

(1)The Mozambican side shall provide necessary information and data to the Team while the Team stays in Mozambique.

(2)The Mozambican side will take all possible measures to secure the safety of the team during the field survey.

A. Awa

(3)The Mozambican side agreed to make the possible use of the existing structure for the bridges which will be reconstructed.

(4)The Team confirmed that Xisadze II Bridge is located on the Route 1, not on the Route 213, as shown in annex 3.

(5)The Mozambican side assured to maintain all roads and bridges leading to the Project site passable before the commencement and during the execution of the Project for the transportation of materials and equipment.

(6)The Mozambican side explained that the mine clearance at the bridges of Annex 1 has already executed; however, the double-checking of the said mine clearance situation will be executed by the Mozambican side by the end of August, 1999.

(7)The Mozambican side explained the design load, and the standard of carriage way and side walk width in Mozambique as per annex 4. The Japanese side will take the information into consideration for the further study of the design and implementation schedule of the Project.

A. Iwai

Annex-1

List of Bridges for the second field survey being requested by the Government of Mozambique

Sr. No.	Rd. No.	River	Province	Note
1	8	Natete	Nampula	Bailey Bridge
2	8	Niose	Nampula	Concrete
3	8	Murusso	Niassa	Bailey Bridge
4	8	Namutimbua	Niassa	Bailey Bridge
5	8	Ningare	Niassa	Bailey Bridge
6	232	Nicaca	Zambezia	No Bridge
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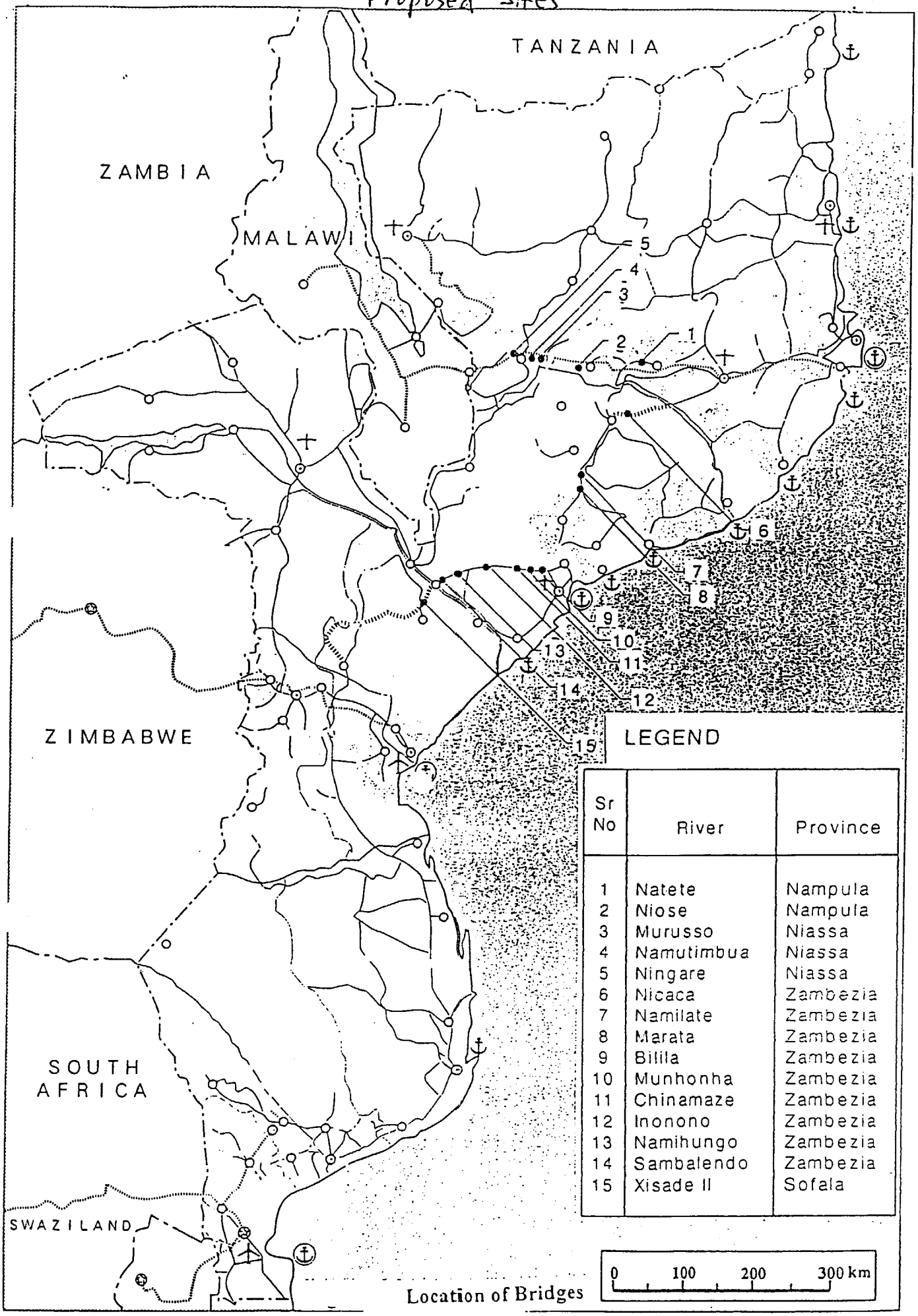
11	225	Chinamaze	Zambezia	Bailey Bridge
12	225	Inonono	Zambezia	Bailey Bridge
13	225	Namihungo	Zambezia	Bailey Bridge
14	225	Sambalendo	Zambezia	Bailey Bridge
15	1	Xisade II	Sofala	Bailey Bridge
Number of Bridges to be investigated				15

Proposed Sites

Annex-2



Sr No	River	Province
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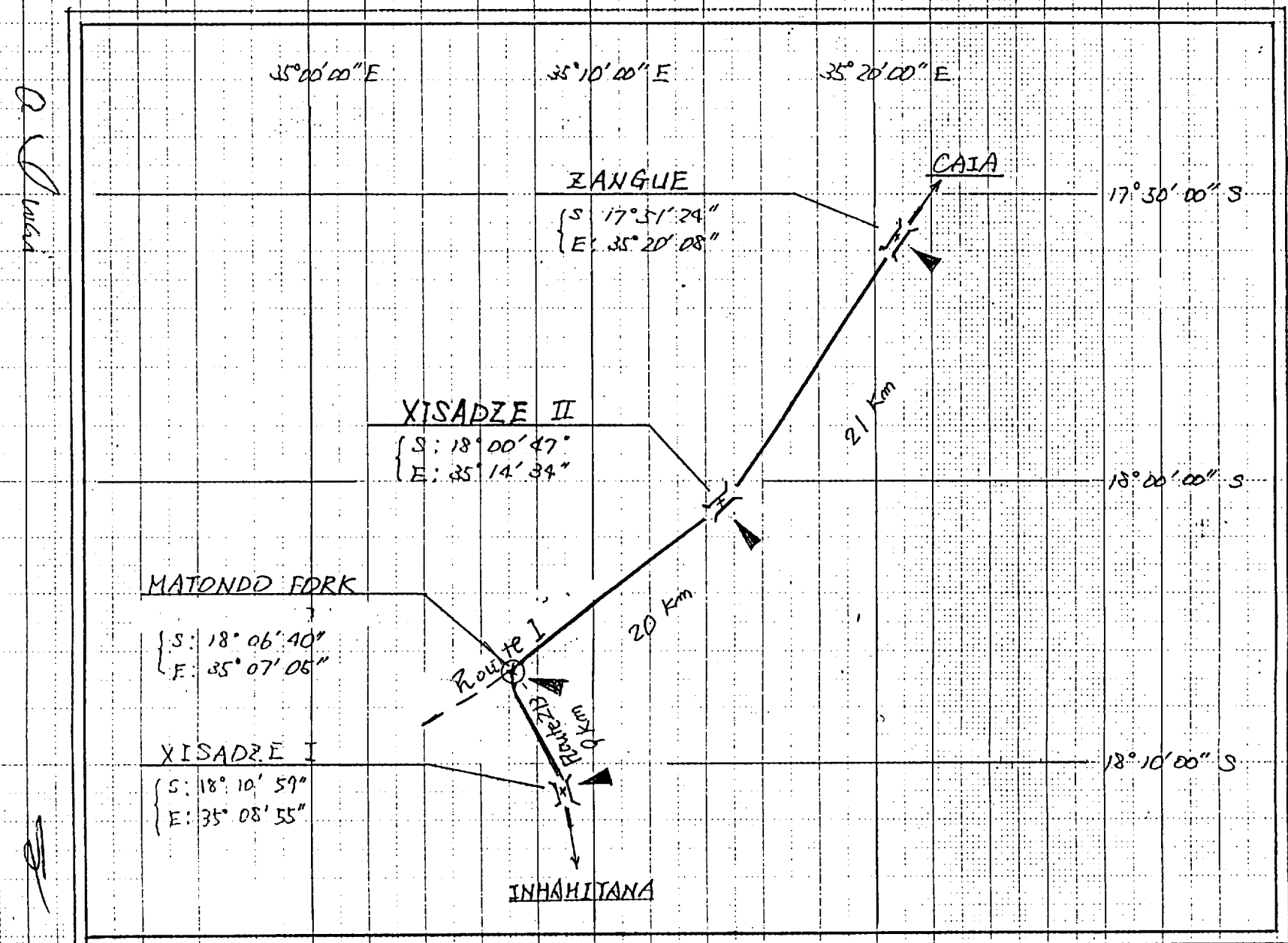
12	Inonono	Zambezia
13	Namihungo	Zambezia
14	Sambalendo	Zambezia
15	Xisade II	Sofala

Location of Bridges


35°00'00" E
35°10'00" E
35°20'00" E
17°30'00" S
18°00'00" S
18°10'00" S
CAIA
ZANGUE
S: 17°51'24"
E: 35°20'08"
XISADZE II
S: 18°00'47"
E: 35°14'34"
MATONDO FORK
S: 18°06'40"
E: 35°07'05"
XISADZE I
S: 18°10'59"
E: 35°08'55"
21 Km
20 Km
9 Km
Route 1
Route 2
INHAMITANA

Annex 3

1 FEEDBACK

1.1 Second Field Study

1.1.1 Objective of the Second Field Study

The following section outlines the comments and/or additional information relating to the specific items raised within the Interim Report.

Item 3-2 Design load
It is again emphasised that, given that the bridges covered by this Project request are all short span bridges, the design load recommended (Japanese 25t with a 60t safety check) is accepted.

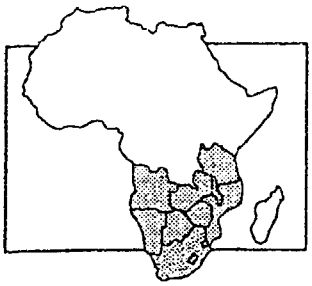
Item 4-2 4)
DNEP are currently finalizing the appointment of a contractor to undertake the partial upgrade and routine maintenance of the section of Route 213 from Dondo - Caia. Furthermore the procurement for the construction of the portion of the EN1 from Gorongoza to Caia is also completed. Mobilization for these two works contracts is expected by September 1999. The completion of the first being early 2000.

Item 4-2 5)
In order to ensure conformity within all the SADC region the Southern African Transport and Communications Commission have implemented a new Code of Practice for the Geometric Design of trunk roads. Further general specifications and bridge design requirements have also been formulated.

Based on the above, the geometric and safety requirements require lane widths of not less than 3.4m at restriction (eg bridges and drifts). With allowances for roadmarking and drainage channels (0.2m) this provides a carriageway width of 7.2m.

The SATCC requirements generally recommend walkway and shoulder widths of 1.0 - 1.5 meters as a minimum. If a average if 1.2m is accepted for the walkway on either side, an overall clearance of 9.6m between the parapets is recommended.

Item 4-2 6)
A level 1 mine clearance investigation has been completed and the Moçambican government is currently arranging for the further clearance operations to be undertaken.



SATCC

Draft

Code of Practice for the Geometric Design of Trunk Roads

September 1998

Prepared by the Division of Roads and Transport Technology, CSIR

5 CROSS-SECTIONAL ELEMENTS

5.1 Introduction

The cross-section of a road provides accommodation for moving and parked vehicles, drainage, public utilities and pedestrians. For the safety and convenience of drivers, wide lanes and shoulders and gently sloping border areas are desirable, since they forgive minor errors of judgment and promote ease of operation.

Cross-sectional dimensions are discussed in the following sections. Figure 5.1 illustrates the various components of the cross-section and the nomenclature employed in this document.

Alternatives to the dimensions suggested may be appropriate for particular conditions. Variations should be selected to suit these conditions. Careful consideration should be given to the function of the cross-sectional element before departing from the recommended values. Where a variation is local, eg to accommodate the use of a narrow structure because it is not economically feasible to replace or upgrade it, due attention must be paid to the provision of adequate road signs and markings warning drivers of the inconsistency in design.

5.2 Lanes

5.2.1 Basic or through lanes

Undivided roads may have either one lane in each direction (two-lane two-way roads) or more than one lane in each direction (multi-lane roads). Dual carriageway roads have two or more lanes in each direction and are described in terms of the total number of lanes, e.g. as four-lane divided or six-lane divided roads. Roads at the tertiary level of the hierarchy may have only one lane with provision being made at intervals for passing.

Customarily, there is symmetry of through lanes, and assymmetry on a particular section of road should arise only from the addition of an auxiliary lane that is clearly allocated to one direction of travel. Three-lane two-way roads have been built that were intended to function as two-lane two-way roads with a continuous central passing lane. These roads were found to have twice the capacity of two-lane two-way roads, but they have been abandoned, in spite of the saving in construction costs resulting from the narrower cross-section, because the practical effect of the three-lane cross-section is to concentrate the faster vehicles of the two opposing traffic streams in a common lane. This is similar to the situation found in the overtaking manoeuvre on a two-lane road, but in the latter case it is clear which of two opposing vehicles has the right of way. When three-lane roads are marked only as having three lanes with no passing restrictions, there is no clarity regarding right of way; it is this lack of clarity that causes three-lane roads to be unsafe.

The selection of lane width is based on traffic volume and vehicle type and speed. Higher volumes and speeds require wider lanes, and the greatest lane width recommended is 3,7 m. No operational or safety benefit accrues from lane widths wider than 3,7 m although, for different reasons, urban lane widths can be as great as 5,5 m. The narrowest width recommended is 3,1 m, giving a clear space of 0,3 m on either side of a vehicle that is 2,5 m wide. This lane width will normally be employed only where speeds or traffic volumes are expected to be low. Intermediate conditions of volume and speed can be adequately catered for by a lane width of 3,4 m.

Where traffic volumes are such that a multi-lane cross-section or a divided cross-section is required, 3,7 m is a logical lane width to adopt. Lesser lane widths may however be warranted by abnormal circumstances.

5.2.2 Passing lanes

As stated earlier, passing lanes are auxiliary lanes added to the outside of the travelled way and are intended to increase the overall capacity of a road by increasing the passing opportunities provided.

As a rule of thumb, it is suggested that passenger car speeds should not decrease to less than 60 km/h in mountainous terrain or 100 km/h on flat or rolling terrain. Table 5.1 offers, for various percentages of passing opportunity, values of ADT above which passing lanes should be provided in order to match this suggestion. Tapers and the other considerations applying to climbing lanes are equally applicable to passing lanes.

TABLE 5.1: VALUES OF ADT WARRANTING THE PROVISION OF PASSING LANES

Terrain Type	% Passing opportunity	Maximum ADT
Mountainous	60	5 860
	40	3 540
	20	2 620
	10	2 080
Rolling	60	6 000
	40	4 300
	20	3 330
	10	2 790
Flat	60	5 810
	40	5 078
	20	4 200
	10	3 630

5.3 Shoulders

The shoulder is defined as the usable area alongside the travelled way. Its width does not, therefore, make provision for the mounting of guardrails, for edge drains or for shoulder rounding. The shoulder breakpoint is some distance beyond the edge of the usable shoulder. This distance is usually about 0,5 to 1,0 m.

There are many possible uses for shoulders, including roadside vending, but emergency stopping is the only consideration applied in this document. A stopped vehicle can be adequately accommodated by a shoulder which is 3,0 m wide, and there is no merit in adopting a shoulder width greater than this. The shoulder should not, on the other hand, be so narrow that a stopped vehicle would cause congestion by

forcing vehicles travelling in both directions into a single lane. However, a partly blocked lane is acceptable under conditions of low speed and low traffic volume. Assuming the narrowest width of through lane, i.e. 3,1 m, it is possible for two vehicles to pass each other next to a stopped vehicle if the shoulders are not less than 1,0 m wide, giving a total cross-sectional width of 8,2 m to accommodate three vehicles. It must be stressed that this width is an irreducible minimum and appropriate only to low lane volumes and low speeds, such as are encountered in climbing lanes. Hazards, including the edges of high fills, tend, if located closer than 1,5 m to the lane edge, to cause a lateral shift of vehicles. For speeds higher than 60 km/h, a shoulder width of 1,5 m should be regarded as the minimum.

Intermediate traffic volumes and higher operating speeds require a shoulder width greater than 1,0 m. Three alternative shoulder widths are suggested, namely 1,5 m, 2,0 m and 2,5 m. The 3,0 m shoulder is appropriate for the highest operating speeds and heavy traffic volumes.

Where the traffic situation dictates a dual-carriageway cross-section, the highest standard of shoulder width is called for, namely 3,0 m in the case of the outer shoulder. Only 1,0 m is required for the inner shoulder where it would be possible to move a broken-down vehicle onto the median and thus clear the lane, or where the vehicle would have to be moved across one lane only to reach the safety of the outer shoulder, as would occur on a four-lane divided road. As it is generally conceded that crossing two lanes with a defective vehicle could be very difficult, a six-lane divided road should have inner shoulders 3,0 m wide. The intermediate shoulder widths suggested above would not normally be used for the inner shoulders of a divided road.

The surfacing of shoulders is recommended:

- for freeways;
- in front of guardrails;
- where the total gradient, i.e. the resultant of the longitudinal gradient and the camber (or superelevation), exceeds 5 per cent;
- where the materials of which the shoulders are constructed are readily erodible, or where the availability of materials for shoulder maintenance is restricted;
- where heavy vehicles would tend to use the shoulder as an auxiliary lane;
- in mist belts;
- wherever it is economically justified;
- wherever significant usage by pedestrians occurs (as specified in Chapter 11).

A patchwork of surfaced shoulders is both unsafe and unsightly. Where the lengths of intervening unsurfaced shoulders would be relatively short, it is suggested that they should also be surfaced. If a warrant exists for surfacing 60% of the shoulders on a route, the balance should also be surfaced.

5.4 Medians

The median is the total area between the inner edges of the inside traffic lanes of a divided road, and includes the inner shoulders and central island. The purpose of the median is to separate opposing streams of traffic hence reducing the possibility of vehicles crossing into the path of opposing traffic. This is accomplished by the selection of the width of the median or by a physical barrier such as a guardrail. Medians are also used to reduce the nuisance of headlight glare by the planting of shrubs on the central island. The shrubs should not grow so tall that sunlight could fall into the driver's eyes in bands - the stroboscopic effect encountered in avenues of trees in the early morning or late afternoon. In addition, the stems of the shrubs should not grow so thick as to become a further possible hazard to the motorist; a maximum stem thickness of 100 mm is recommended. Medians should, as far as

Minutes of Discussions
on
the Basic Design Study
on
the Project for Reconstruction of Bridges on the Main National Roads II
in
the Republic of Mozambique
(Explanation of Draft Report)

In May and July, 1999, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched Basic Design Study Team on the Project for Reconstruction of Bridges on the Main National Roads II (hereinafter referred to as "the Project") to the Republic of Mozambique (hereinafter referred to as "Mozambique"), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult the Government of Mozambique on the components of the draft report, JICA sent to Mozambique the Draft Report Explanation Team (hereinafter referred to as " the Team "), which is headed by Mr. Shinji Obuchi, First Training Division, Tokyo International Center, JICA , from October 21 to October 28, 1999.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Maputo, October 27, 1999

Mr. Shinji Obuchi
Leader
Basic Design Study Team
Japan International Cooperation Agency
Japan

Mr. Carlos Fragoso
Chairman
National Road Administration Board
Ministry of Public Works
and Housing
Republic of Mozambique

ATTACHMENT

1. REORGANIZATION TO NATIONAL ROAD ADMINISTRATION (ANE, ADMINISTRAÇÃO NACIONAL DE ESTRADAS)

The Mozambican side explained the Team that the name of implementing agency shall be changed to National Road Administration (ANE ; Administração Nacional de Estradas) from National Directorate of Roads and Bridges (DNEP ; Direcção Nacional de Estradas e Pontes). The Team also confirmed that the responsible agency for ANE is the Ministry of Public Works and Housing, and ANE is the public organization under the Government of Mozambique.

The Team accepted their explanation and the background and the function of ANE is mentioned in ANNEX 1.

2. COMPONENTS OF THE DRAFT REPORT

The Mozambican side agreed and accepted in principle the components of the draft report explained by the Team.

3. JAPAN'S GRANT AID SCHEME

The Mozambican side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Mozambique as explained by the Team and described in Annex-4 and Annex-5 of the Minutes of Discussions signed by both parties on June 3, 1999, and described in Other Relevant Issues of the Minutes of Discussions signed by both parties on July 8, 1999.

4. SCHEDULE OF THE STUDY

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Mozambique by the end of January, 2000.

5. OTHER RELEVANT ISSUES

5.1 Implementation Order of Each of Bridges

Both side agreed that the implementation order of bridges shall in principle be the schedule as per ANNEX-2. However, the Mozambican side requested that the implementation of Xisade II Bridge should be earlier than the schedule in order to meet the construction program of the project between Gorongosa and Caia on Route 1 under the USAID because the project will start shortly with 30 months construction period.

5.2 Mine Clearance

The Mozambican side explained that the mine clearance at 15 bridges will be carried out by the Mozambican side from November and completed by the end of January, 2000. The Mozambican side has agreed in plinciple to submit the certificate of the mine clearance at the end of each month until January, 2000. The Mozambican side submitted the related documents (Agreement and Memorandum including maps with the contractor) that shows the demining area of bridges as per attached in ANNEX-3.

5.3 Means to Secure the Security in the Area

The Mozambican side promised to take necessary actions for securing the security in the construction area at the implementation stage of the Project. As one of these necessary actions, the Mozambican side considers the issuance of ID cards to all the personnel engaged in the Project to regulate the unauthorized and unrelated entries.

5.4 Maintenance of constructed bridge

During field survey, the Team observed the slope and riverbed are protected properly by the Mozambican side at the Mecuburi Bridge and ThiThi Bridge which have been completed in the previous Project.

ANNEX - 1

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DAS OBRAS PÚBLICAS E HABITAÇÃO
ADMINISTRAÇÃO NACIONAL DE ESTRADAS
TELEFONES 47 61 63/7 - TELEX 6471 & 6884 ANE MO - FAX 47 55 33
Av. de Moçambique, Nº 1225 - Caixa Postal 403 - Maputo

DIRECÇÃO

TO:

GRANT AID MANAGEMENT
DEPARTMENT - JICA

TOKIO - JAPÃO

Sua referência	Sua comunicação de	Nossa referência	Nossa comunicação de
	2343/	166/DNA/99	26/10/199

SUBJECT: CHANGE OF STATUS OF NATIONAL DIRECTORATE OF ROADS AND BRIDGES.

By ministerial Decrees 14/99 and 15/99 both of 27 of April 1999, the Council of Ministers provided the enabling legislation for the establishment of a National Road Administration (ANE), authority to take the place of the National Directorate of Roads and Bridges (DNEP).

The ANE has now been established and assumed all of the responsabilities and obligations of DNEP and as a consequence, in accordance with Article 6 of Decree 14/99, DNEP has cesead to exist.

You are therefore requested to direct all future communication to the ANE.

Should you have any queries on this change please do not hesitate to contact ourselves.

Attached please find the following documents:

- Decree 14/99 of 27/4/99, Roads Administration System;
- Decree 15/99 of 27/4/99, Statute of the National Roads Adminitartion; and
- Resolution No. 50/98 of 28/7/98, The Road Policy.

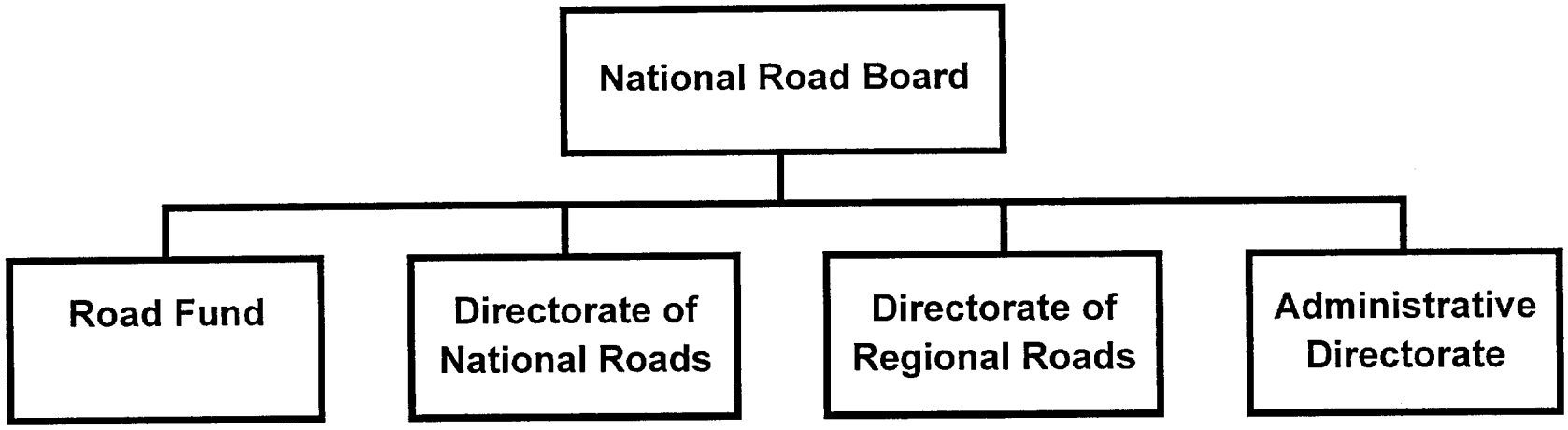
The Chairman

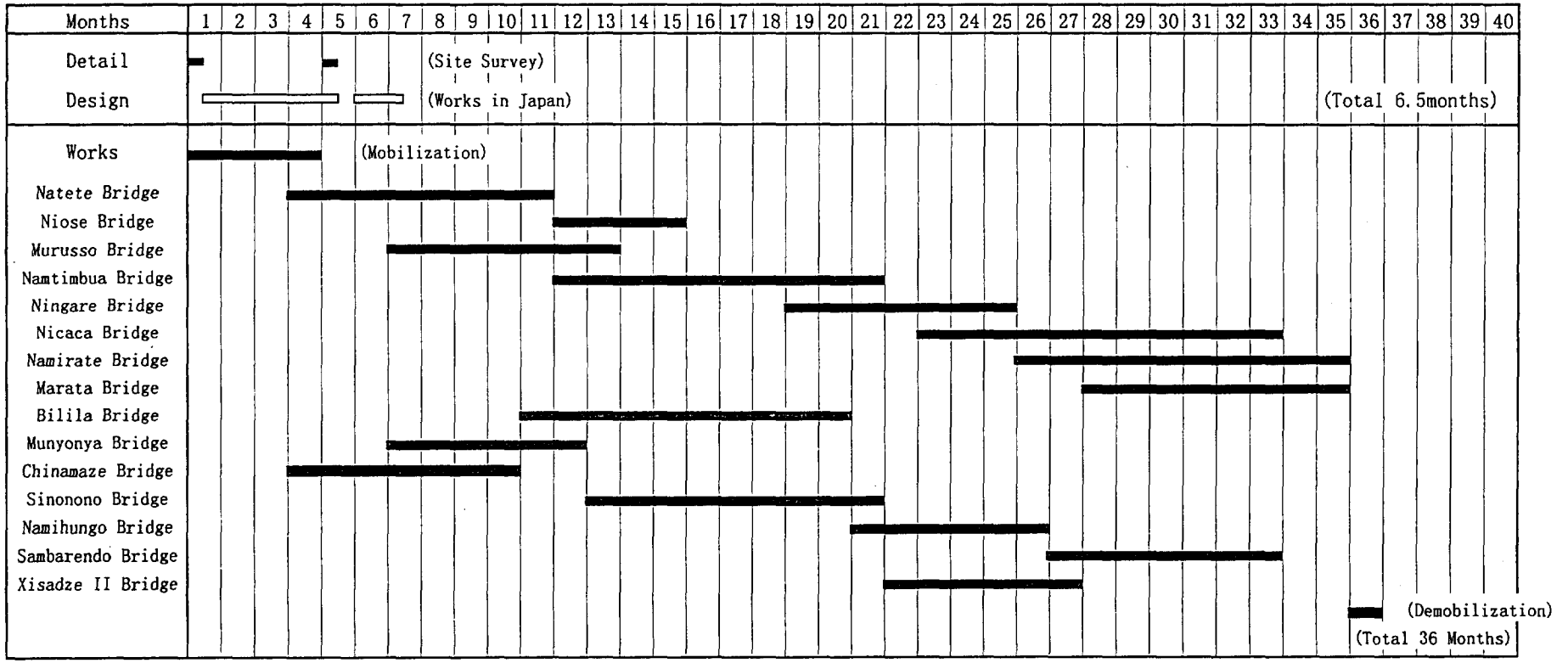
Carlos Fragoso

C C.: Ministry of Foreign Affairs.

A:\carta24 - JAPÃO.wpd

MINISTRY OF PUBLIC WORKS ANS HOUSING
NATIONAL ROAD ADMINISTRATION
(Administração Nacional de Estradas - ANE)




Months
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
Detail
(Site Survey)
Design
(Works in Japan)
(Total 6.5months)
Works
(Mobilization)
Natete Bridge
Niose Bridge
Murusso Bridge
Namtimbua Bridge
Ningare Bridge
Nicaca Bridge
Namirate Bridge
Marata Bridge
Bilila Bridge
Munyonya Bridge
Chinamaze Bridge
Sinonono Bridge
Namihungo Bridge
Sambarendo Bridge
Xisadze II Bridge
(Demobilization)
(Total 36 Months)

ANNEX-2

ANNEX-3

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DAS OBRAS PÚBLICAS E HABITAÇÃO
DIRECÇÃO NACIONAL DE ESTRADAS E PONTES
TELEFONES 47 61 63/7 - TELEX 6471 & 6884 DNEP MO - FAX 47 55 33
Av. de Moçambique, Nº 1225 - Caixa Postal 403 - Maputo

DEMINING OF THE EN 7 - SECTION BETWEEN QUELIMANE AND NAMACURRA

PROVINCE OF ZAMBÉZIA
MOÇAMBIQUE

CONTRACT NO. 460/DESM/99

FEBRUARY 1999

GENERAL CONTENTS

CONTRACT NO. 460/DESM/99

The National Road and Bridges Authority (DNEP - Direcção Nacional de Estradas e Pontes), acting as The Employer,

and

AFROVITA - Associação para a Segurança e o Desenvolvimento Rural, acting as The Contractor,

are celebrating this Contract for the demining of the road between Quelimane and Namacurra, as well as its bridges, borrow-pits and culverts.

I
CONTRACT VALUE

The Employer agrees in paying the works in the value of USD 297 084.74 and payments will be made on a measurement basis.

II
DEMINING METHODOLOGY

AFROVITA will carry out the demining manually. In areas where mines with a very low metal content might be installed, or where dense and high vegetation may exist, the manual demining will be supported by an armoured Caterpillar D5, equiped with a roller with penetrating edges or, alternatively, with a blade.

The areas to be demined will be divided in 1m wide and 50m long strips. The deminers search at this lanes gap free and overlapping, with a high sensitive metal (mine) detector.

Every signal of the detectors indicates a metal piece. The metal has to be assessed and removed, whether it is a mine or another explosive object, whether it is a part of these items or even any other harmless metal piece. Mines and other explosive objects will be destroyed at the spot and other metal pieces have to be collected, in order to leave the ground metal free for the later quality control.

If there are areas with huge quantities of metal pieces, the ground will be penetrated and probed with prodders up to a depth of 25cm, in order to find solid objects which might be mines or other explosive objects which could not be identified by the metal detectors.

The areas cleared will be marked with red and white painted wooden poles, in order to indicate the borders of the zones which may be considered free of mines and of other explosive objects.

III
DEMINING EQUIPMENT

The demining equipment, as well as the transport, communications, medevac and accomodation facilities which will be used by AFROVITA to carry-out the work referred to in this Contract, is object of its attachement 3.

IV
DEMINING PROGRAMME

The Reconnaissance Report edited by AFROVITA, and especially its conclusions ans recommendations, will be considered the general guideline for the demining works. The Reconnaissance Report is the attachement 4 of this Contract.

1. The demining will be carried-out by AFROVITA in accordance with the work-plan to be agreed with Mott MacDonald, acting as The Consulting Engineer, on behalf of DNEP. The work-plan will take into consideration the bill of quantities referred to in the annex of AV.175.98, dated December 29, 1998, which is the attachement 1 of this Contract, and will also be part of this Contract, as its attachement 2.

2. No changes may be introduced in the work-plan, unless agreed by both Parties.

V
DEMINING CONDITIONS

1. AFROVITA will follow the work-plan mentioned above, which defines order and priorities of clearance, time frame and methodology.

2. As guaranty for the best clearance results achievable, AFROVITA will follow the ISO 9000 guidelines and be subject to quality control carried-out by an independent Quality Assurance (QA) organization, to be proposed to DNEP by the National

Demining Commission (CND).

3. The QA staff members will be hosted and supported by AFROVITA on site, in a way that will enable them to execute their task efficiently and comprehensively. They will have free movement at the demining site, access to all relevant documentation and guidance by the supervisors at the spot, during their inspection visits.

4. AFROVITA will redo the deming without additional costs to DNEP, in those areas to which the independent QA organization should have denied the successful completion of work.

5. AFROVITA is not responsible:

   a. For delays caused by the interruption of works decided by The Contractor, or to which he might be subject;

   b. For delays caused by adverse weather conditions, nature disasters or armed conflicts;

   c.For mines placed or washed into areas which have been cleared;

   d. For mines placed in areas outside the established perimetres for demining.

VI
CERTIFICATION

1. After completion of portions of areas and road sections demined, AFROVITA will certificate in writing to DNEP and to The Consulting Engineer the exact coordinates of the cleared areas and road sections, as well as its quantities in kilometres and hectars.

2. The Certification of Completed Work will be edited monthly and attached to the monthly AFROVITA invoice to DNEP.

VII
TERMS OF PAYMENT

1. The Employer will pay to AFROVITA a mobilization advance of 20% of the total amount of this Contract, as shown in the annex of AV.175.98, mentioned above (attachement 1 of this Contract).

2. Further payments will be made monthly by The Employer to AFROVITA, in accordance to the invoices presented.

VIII
MOBILIZATION

The start of the demining works will take place 15 days after reception of the mobilization down-payment.

IX
AMENDMENTS

No amendments to this Contract can be made, unless agreed by both Parties in writing.

X
ARBITRATION

All disputes which may arise in connection with this Contract will be settled under the Mozambican law, by a local Court established in the city of Maputo.

Signed in Maputo, the of January,1999

For DNEP

CARLOS FRAGOSO
DIRECTOR NACIONAL

30 APR 1999

For AFROVITA

AFROVITA
MAPUTO - Moçambique

CHRISTIANO STEIN
GENERAL DIRECTOR

5. Results of Hydrological Study

1.River Basins and River Conditions

River basins and river conditions of 15 bridges are summarized as shown in Table-1.

Table-1 River Basins and River Conditions

No.	Name	Catchment Area (km^2)	River Length L (1) (km)	Ground Elevation at Bridge Site (2) (m)	Uppermost Elevation (3) (m)	Head H (4) = (3) – (2) (m)	Inclination H/L (4) / (1)
1	Natete	38	7.7	576	640	64	1/120
2	Niose	115	14.4	643	760	117	1/123
3	Murusso	90	21.9	551	700	149	1/147
4	Namutinbua	470	63.0	557	660	103	1/612
5	Ningare	94	10.3	581	620	39	1/264
6	Nicaca	28	8.5	404	500	96	1/89
7	Namilate	21	8.2	303	400	97	1/85
8	Marata	9	4.1	206	240	34	1/121
9	Bilila	19	5.0	25	40	15	1/333
10	Munhonha	15	5.7	34	60	26	1/219
11	Chinamaze	11	4.3	38	60	22	1/195
12	Namihungo	7	3.4	70	100	30	1/113
13	Sinonono	6	4.3	138	160	22	1/195
14	Sambarendo	12	7.9	134	180	46	1/172
15	Xisadze II	370	62.0	59	260	201	1/308

2.Daily Rainfall

Probable daily rainfall of 2 and 50 years and an annual maximum daily rainfall estimated from three observatories (Cuamba, Nampula and Quelimane) are as shown in Table-2.

Table-2 Daily Rainfall

No.	River Name	Daily Rainfall (mm)		
		2 years Probable	50 years Probable	Maximum
1	Natete	80	160	170
2	Niose	80	160	170
3	Murusso	70	140	140
4	Namutinbua	70	140	140
5	Ningare	70	140	140
6	Nicaca	80	160	170
7	Namirate	90	190	220
8	Marata	90	190	220
9	Bilila	120	260	330
10	Munhonha	120	260	330
11	Chinamaze	120	260	330
12	Sinonono	120	260	330
13	Namihungo	120	260	330
14	Sambarendo	120	260	330
15	Xisadze II	120	260	330

3. Run-off

Following formulas were used for calculating run-off.

(1) Peak Discharge

$Qp = f \times r \times A / 3.6$

Where; Qp : Peak Discharge (m^3/s)
f : Run-off coefficient
r : Mean rainfall intensity during the concentration time (mm/hr)
A : Catchment area (km^2)

(2) Time of Concentration

1) Rziha's Formula

$t = L/w$
$w = 20 \times (H/L)^{0.6}$

Where; t : duration of rainfall intensity equal to time of concentration (s)
w : flood run-off velocity (m/s)
L : river length (km)
H : head between a bridge site and a point of uppermost stream (m)

2) USBR Stream Flow Equation

$tc = \{(0.87 \times L^2) / (1000 \times S)\}^{0.385}$

Where; tc : time of concentration (hr)
S : L/H
L : river length (km)
H : head between a bridge site and a point of uppermost stream (km)

3) Rainfall Intensity (r)

Mononobe's Formula

$r = (Rd / 24) \times (24 / t)^{2/3}$

Where; r : rainfall intensity (mm/hr)
Rd : Daily Rainfall (mm)
t : time of concentration (hr)

The results of run-off are as shown in Table-3.

Table-3 Run-off

No.	Bridge Name	Tc (hr)	Design Run-off (m^3/s)			Specific Run-off ($m^3/s/km^2$)		
			Annual Maximum Daily Rainfall	50years Probable Rainfall	2years Probable Rainfall	Annual Maximum Daily Rainfall	50years Probable Rainfall	2years Probable Rainfall
1	Natete	1.89	170	160	80	4.47	4.21	2.11
2	Niose	3.60	350	350	170	3.04	3.04	1.48
3	Murusso	6.08	210	210	110	2.33	2.33	1.22
4	Namtimbua	40.70	470	470	210	1.00	1.00	0.45
5	Ningare	4.09	290	290	140	3.09	3.09	1.49
6	Nicaca	1.74	130	120	70	4.64	4.29	2.50
7	Namirate	1.63	120	100	50	5.71	4.76	2.38
8	Marata	1.01	70	60	30	7.78	6.67	3.33
9	Bilila	2.28	130	100	50	6.84	5.26	2.63
10	Munhonha	2.00	110	90	40	7.33	6.00	2.67
11	Chinamaze	1.42	100	80	40	9.09	7.27	3.64
12	Sinonono	0.81	90	80	40	12.86	11.43	5.71
13	Namihungo	1.42	60	50	20	10.00	8.33	3.33
14	Sambarendo	2.41	80	60	30	6.67	5.00	2.50
15	Xisadze II	26.91	690	540	260	1.86	1.46	0.70

4.Flood Water Level

Flood water level and velocity of each river are as shown in Table-4 and Table-5.

Table-4 Flood Water Level

No	Name of River	Flood Water Level* (m)	Lowest Level of Road (m)	Calculated Water Level (m)		
				Run-off by Annual Maximum Rainfall	Run-off by 50years Probable Rainfall	Run-off by 2years Probable Rainfall
1	Natete	99.5	99.15	98.7	98.6	97.8
2	Niose	97.5	100.21	99.2	99.2	97.9
3	Murusso	99.0	100.17	99.7	99.7	98.5
4	Namtimbua	99.9	99.75	99.9	99.9	98.1
5	Ningare	101.0	99.43	100.9	100.9	99.3
6	Nicaca	98.3	99.97	97.3	97.2	96.1
7	Namirate	-	100.19	98.2	97.7	96.5
8	Marata	98.0	100.12	98.5	98.3	97.3
9	Bilila	97.0	100.38	100.2	99.6	98.5
10	Munhonha	97.0	100.07	99.8	99.4	98.2
11	Chinamaze	98.0	99.89	98.6	98.2	97.4
12	Sinonono	96.0	99.99	99.0	98.8	97.7
13	Namihungo	97.0	100.03	97.9	97.6	96.6
14	Sambarendo	98.0	99.01	97.3	96.8	96.0
15	Xisadze II	-	100.24	99.9	-	-

* Obtained through hearing from local people on site.

Table-5 Flood Water Velocity

No	Name of River	Flood Water Velocity (m/s)		
		Run-off by Annual Maximum Daily Rainfall	Run-off by 50years Probable Rainfall	Run-off by 2years Probable Rainfall
1	Natete	2.4	2.3	2.1
2	Niose	3.6	3.6	2.5
3	Murusso	3.4	3.4	2.8
4	Namtimbua	4.0	4.0	2.8
5	Ningare	3.3	3.3	2.4
6	Nicaca	1.5	1.4	1.1
7	Namirate	3.6	3.4	2.7
8	Marata	3.1	2.9	2.4
9	Bilila	3.6	3.3	2.6
10	Munhonha	3.5	3.1	2.4
11	Cinamaze	3.3	3.0	2.2
12	Sinonono	2.0	1.9	1.3
13	Namihungo	2.5	2.3	1.8
14	Sambarendo	2.0	1.7	1.1
15	Xisadze II	4.7	4.5	2.6

5. Result of Hydrological Study

Table-6 Result of Hydrological Study

No	Name of River	Bridge Opening (m)	High Water Level (m)	Design River Bed (m)	Water Depth (m)	Velocity (m/s)	Bridge Deck Level (m)
1	Natete	29.0	98.6	95.5	3.1	1.4	99.65
2	Niose	20.0	99.2	94.8	4.4	3.6	100.00
3	Murusso	20.0	99.7	95.5	3.0	3.4	100.54
4	Namtimbua	29.0	99.9	94.8	3.3	2.1	100.15
5	Ningare	20.0	100.9	95.6	3.7	1.9	100.54
6	Nicaca	20.0	97.2	93.0	4.2	1.5	100.15
7	Namirate	8.6	97.7	93.7	4.0	3.4	100.08
8	Marata	8.3	98.3	95.0	3.3	3.0	100.58
9	Bilila	9.0	99.6	96.5	3.1	3.3	100.58
10	Munhonha	9.0	99.4	96.5	2.9	3.1	100.43
11	Chinamaze	9.0	98.2	95.5	2.7	3.0	100.08
12	Sinonono	9.0	98.8	94.5	4.3	1.9	100.08
13	Namihungo	9.0	97.6	95.4	2.2	2.3	100.08
14	Sambarendo	9.4	96.8	93.0	2.8	1.7	99.60
15	Xisadze II	18.9	99.9	94.0	5.6	2.6	101.13