Directorate General of Highways
Ministry of Public Workd
Republic of Indonesia

BASIC DESIGN STUDY
ON
THE PROJECT FOR THE IMPROVEMENT
OF
BRIDGES IN NIAS ISLAND
IN
THE REPUBLIC OF INDONESIA

October 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of Bridges in Nias Island and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team from February 10 to March 9, 2008.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Indonesia 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 Indonesia for their close cooperation extended to the teams.

October, 2008

Eiji Hashimoto
Voice-President
Japan International Cooperation Agency

October, 2007

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Improvement of Bridges in Nias Island in the Republic of Indonesia.

This study was conducted by Katahira & Engineers International under a contract to JICA, during the period from January 2008 to October 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Indonesia 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,

Kazuyuki Hiraoka
Project manager,
Basic design study team on the Project
for the Improvement of Bridges in Nias
Island in the Republic of Indonesia
Katahira & Engineers International

Summary

1. Outline of the Country

The area of Indonesia is composed of approximately 18,000 islands. It is the world's largest archipelagic country. With a population of 221,654,500 people in 2006, it is the world's fourth most populous country. The country area is about 1,940,000 square kilometers. Indonesia is the world's 16th largest country in terms of country area. Nias Island is located 125 kilometers west off the shore of Sumatra Island. It is under the jurisdiction of North Sumatra Provincial Government. The island has an area of about 5,625 square km and a population of about 730,000. Nias Island belongs to tropical rainforest climate. Annual rainfall is 2,800 to 3,200 mm. The rainfall is not much different during rainy seasons and dry seasons. Temperatures vary slightly throughout the year; the average daily temperature range is 25–30 °C. Nias Island is located on Indo-Eurasia tectonic plate. Subduction of Indo-Australia tectonic plate under the Indo-Eurasia tectonic plate at west off Nias Island formed Sunda Trench. Such tectonic activities cause earthquakes in the area.

Indonesia has extensive natural resources, including crude oil, natural gas, tin, copper, and gold. Major agricultural products include rubber, rice, palm oil. Indonesia was the country hardest hit by the East Asian monetary crisis in late 1990s. However, the economy has recovered significantly through an economic reform. GDP growth exceeded 5% in both 2004 and 2005, and is forecast to increase further. The growth rate, however, is not enough to make a significant impact on unemployment and stagnant wages growth. And increases in fuel and rice prices have worsened poverty levels. As of 2006, an estimated 17.8% of the population live below the poverty line. 49.0% of the population live on less than US$2 per day, and unemployment rate at 9.75%.

2. Background of the Project

Nias Island was severely stricken by two huge earthquakes, the north Sumatra offing earthquake in December 2004 and the northern Nias offing earthquake in March 2005. Some 2,000 people were reported to have been killed in the island. The road was totally damaged by embankment collapse, slope failure and ground flow caused by liquefaction. As for bridges, damage of pile heads, inclination of piers and abutments caused by ground settlement and flow, while abutment slant along with superstructure collapse took place here and there to a large extent.

Under the situation, the Government of Indonesia has established the BRR (Badan Rehabilitasi dan Rekonstruksi Aceh dan Nias = Rehabilitation and Reconstruction Agency of Aceh and Nias) under BAPPENAS' initiative to realize the master plan for the restoration of Aceh Province and Nias Island, and promoted the restoration programs involving aids from the international financial institutions and NGOs. The restoration programs comprise four pillars as follows: (1)

Reconstruction of houses and communities, (2) Recovery of infrastructures, (3) Development of local economy and (4) Capacity development. The BRR has been leading the restoration programs by restoration of houses, markets, water supply, sewerage, irrigation, airport, ports, roads, bridges, communication and electric power stations and other facilities in Aceh Province and Nias Island. BRR has been implementing restoration of bridges along provincial roads in Nias Island, however, bridges damaged by the earthquakes still remain and are possible to collapse when an earthquake comes. Also, bridges restored with temporary structures are obstructing the traffic.

Taking the situation into account, the Government of Indonesia (GOI) requested assistance from the Government of Japan (GOJ) for the restoration of seven bridges. In response to the request, a preliminary study was conducted in July 2007. The preliminary study team found that 4 of the requested bridges had been reconstructed or committed to be reconstructed, and 2 of the requested bridges were damaged slightly but structurally stable. Consequently, those 6 bridges were excluded from the study. Meanwhile, there were bridges which were necessary to be reconstructed urgently but not included in any restoration program. The study team has made discussions with the Indonesian concerned parties that the newly requested 6 bridges including one originally requested bridge were decided to be the subject of the study.

3. Outlines of the Survey Results and Contents of the Project

Japan International Corporation Agency (JICA) sent a basic design study team to Indonesia from February 10 to March 9, 2008 in order to make discussions with the concerned officials of the Government of Indonesia and conducted a field study at the study area. On their return to Japan, further studies were made to develop an optimum basic design of the bridge facilities, and a draft final report was prepared. Then, JICA sent a mission to Indonesia from July 24 to August 2, 2008 for discussions on the draft basic design, which results in finalizing the report.

The design policy employed for the planning of the Project bridges is as follows:

- Design specifications issued by the Ministry of Public Works, Indonesia are basically applied.
- Integral type structure, which is seismic resistant, is adopted since Nias Island is prone to earthquake.
- Steel girder is used for the superstructure since it is superior to concrete girder in terms of seismic resistance, construction ease and construction safety, while both are nearly the same in terms of cost and maintenance requirement.
- New bridge locations are selected to minimize resettlement and land acquisition.
- The bridges are planned to be optimum to the site conditions.
- Cost efficiency should be considered in bridge planning and construction planning. All materials and equipment are planned to be procured from Indonesia.
- Maintenance requirement should be minimized.

The Project bridges are planned on the basis of the above policies. The components of the Project bridge facilities are as summarized in the following table.

Components of the Project Bridge Facilities

Bridge Name		Nou	Nou A	Gido Si'ite	Idano Gawo	Mezaya	Sa'ua
Bridge Length		41.5 m	49.5 m	40.0 m	151.0 m	94.0 m	53.5 m
Span		1@41.5	2@24.75	1@40.0	3.0+32.0+ 2@42.0+32.0	29.0+36.0+ 29.0	2@26.75
Bridge Width	Carriageway	7.0 m	6.0 m	6.0 m	6.0 m	6.0 m	6.0 m
	Sidewalk	1.0 m	0.5 m	0.5 m	0.5 m	0.5 m	0.5 m
	Total	9.5 m	7.5 m	7.5 m	7.5 m	7.5 m	7.5 m
Superstructure Type		Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder
Substructure Type		Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent
Bridge Deck Pavement		AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)
Approach Road Length		70.8 m	90.5 m	180.0 m	209.0 m	181.0 m	186.5 m
App. Road Width	Carriageway	7.0 m	6.0 m	6.0 m	6.0 m	6.0 m	6.0 m
	Sidewalk	1.0 m	1.0 m	1.0 m	1.0 m	1.0 m	1.0 m
Approach Road Pavement		AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)
Approach Road Retaining Wall Length		39.0 m	73.0 m	0.0	0.0	95.0 m	129.0 m
Revetment Type		PC Sheet Pile	PC Sheet Pile	Gabion Mattress	Gabion Mattress	Gabion+Wall+ Conc. Block	Wall + Conc. Block
Revetment Quantity		74.0 m	48.0 m	Gabion 53 ea.	Gabion 680 ea.	Gabion 22ea+ Wall 17.0m + Conc. Block 25 ea.	Wall 42.0 m, Conc. Block 486 ea.

Total Bridge Length	429.5 m
Total Approach Road Length	917.8 m

4. Project Period and Rough Cost Estimate

In case the Project is implemented, the detailed design will take 6.8 months and the construction will take 20.5 months. The Project will be implemented in accordance with the Japan's Grant Aid scheme and the cost will be determined before concluding the Exchange of Notes (E/N) for the Project.

5. Project Evaluation

The direct beneficiaries of the Project are the population along the Provincial Road No. 75 (Approximately 500,000), whereas the indirect beneficiaries are the population of Nias Island (Approximately 730,000).

(1) Direct Effects

- The existing bridges are unsafe as they have been damaged by the earthquakes and will possibly collapse when an earthquake comes, while seismic resistant bridges will secure safe and reliable traffic facilities.

- The existing bridges force vehicles to slow down due to large gaps on bridge deck of Nou Bridge and Gido Si'ite Bridge, hard vibration from the temporary bridges of Idano Gawo Bridge and Sa'ua Bridge and weak wooden deck slab of Mezaya Bridge, while on the new bridge motor-vehicles can run faster. (Present vehicle traffic speed at 5 to 20 km/hr will increase to 40 to 60 km/hr after the Project.)

- The single lane bridges (Nou A Bridge, Idano Gawo Bridge, Mezaya Bridge and Sa'ua Bridge) delay traffic from one of both directions. While the new bridges will allow both traffic directions without stopping and waiting.

- The temporary bailey bridges, Idano Gawo and Sa'ua bridges are impassable for vehicles heavier than 6 tons and B-class truss, Nou A and Mezaya bridges, are impassable for vehicles heavier than 15 tons, while the new bridges will be passable for vehicles of any size. And the transportation of goods become more efficient by using large capacity trucks.

- Nou Bridge which is located along Provincial road No. 75 in Gunung Sitoli causes traffic congestion during commuting hours. Replacing Nou bridge with another bridge 1 m wider than the existing bridge and replacing Nou A bridge which is a single lane bridge at the downstream side of Nou bridge with 2-lane bridge will mitigate the traffic congestion.

(2) Indirect Effects

- Providing efficient and reliable transportation facilities means improving accessibility for residents to public services and also stimulating socio-economic activities in the island. And it will result in contributing to achieve the overall objectives of earthquake disaster restoration.

- Construction of earthquake-resistant bridge improves level of disaster prevention of the Island's trunk road. It secures the road for evacuation and transportation of relief goods in case of disasters.

6. Recommendations

Since the project will make significant effects as mentioned above and contribute to the improvement of the residents' living condition, the project will be worth being implemented under the Japan's grant aid.

In order to realize, enlarge and sustain the effects of the Project, responsibilities to be undertaken

by the Indonesian side are as follows:

- To adequately carry out maintenance and repair works to keep the road and bridges in good condition and in order to maximize their serviceable lives.
- To review and maximize the efficiency of the road network traffic operation connected to Nou and Nou A Bridge in Gunung Sitoli on the opening of the new bridges.

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LOCATION MAP OF STUDY BRIDGES

Perspective (Sa’ua Bridge)

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Abbreviations

AASHTO	: American Association of State Highway and Transport Officials
AMDAL	: Environmental Impact Assessment (Analisis Mengenai Dampak Lingkungan Hidup)
BAPEDALDA	: Regional Environmental Impact Management Agency (Badan Pengendalian Dampak Lingkungan Daerah)
BAPPENAS	: National Development Planning Agency (Badan Perencanaan Pembangunan Nasional)
BRR	: Rehabilitation and Reconstruction Agency of Aceh and Nias (Badan Rehabilitasi dan Rekonstruksi Aceh dan Nias)
DGH	: Directorate General of Highways
EIA	: Environmental Impact Assessment
E/N	: Exchange of Note
GDP	: Gross Domestic Products
IREP	: Infrastructure Reconstruction Enabling Program
JIS	: Japan Industrial Standards
M/D	: Minutes of Discussions
MPW	: Ministry of Public Works
NGO	: Non Governmental Organization
ODA	: Official Development Aid
PAPs	: Project Affected Persons
PC	: Prestressed Concrete
RC	: Reinforced Concrete
Rp	: Rupiah (Indonesian currency)
Sta.	: Station
UKL	: Environmental Management Measures (Upaya Pengelolaan Lingkungan Hidup)
UPL	: Environmental Monitoring Measures (Upaya Pemantauan Lingkungan Hidup)

CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 BACKGROUND, HISTORY AND OUTLINE OF THE PROJECT

Nias Island was severely stricken by two huge earthquakes, the north Sumatra offing earthquake in December 2004 and the northern Nias offing earthquake in March 2005. Some 2,000 people were reported to have been killed in the island. The road was totally damaged by embankment collapse, slope failure and ground flow caused by liquefaction. As for bridges, damage of pile heads, inclination of piers and abutments caused by ground settlement and flow, while abutment slant along with superstructure collapse took place here and there to a large extent.

Under the situation, the Government of Indonesia has established the BRR (Badan Rehabilitasi dan Rekonstruksi Aceh dan Nias = Rehabilitation and Reconstruction Agency of Aceh and Nias) under BAPPENAS' initiative to realize the master plan for the restoration of Aceh Province and Nias Island, and promoted the restoration programs involving aids from the international financial institutions and NGOs. The restoration programs comprise four pillars as follows: (1) Reconstruction of houses and communities, (2) Recovery of infrastructures, (3) Development of local economy and (4) Capacity development. The BRR has been leading the restoration programs by restoration of houses, markets, water supply, sewerage, irrigation, airport, ports, roads, bridges, communication and electric power stations and other facilities in Aceh Province and Nias Island. BRR has been implementing restoration of bridges along provincial roads in Nias Island, however, bridges damaged by the earthquakes still remain and are possible to collapse when earthquakes come. Also, bridges restored with temporary structures are obstructing the traffic.

Taking the situation into account, the Government of Indonesia (GOI) requested assistance from the Government of Japan (GOJ) for the restoration of seven bridges. In response to the request, a preliminary study was conducted in July 2007. The preliminary study team found that 4 of the requested bridges had been reconstructed or committed to be reconstructed, and 2 of the requested bridges were damaged slightly but structurally stable. Consequently, those 6 bridges were excluded from the study. Meanwhile, there were bridges which were necessary to be reconstructed urgently but not included in any restoration program. The study team has made discussions with the Indonesian concerned parties that the newly requested 6 bridges including one originally requested bridge were decided to be the subject of the study.

This project is to reconstruct the 6 bridges damaged by the earthquakes and currently unreliable and obstructing the traffic. The present condition and the reconstruction necessity of the bridges are summarized on Table 1.1-1.

Table 1.1-1 Present Condition and Reconstruction Necessity of the Project Bridges

Bridge	Present Condition	Probable Cause	Reconstruction Necessity
Nou Bridge Sta. 0.6 km 3-span RC type L=11+26+11=48m	・The center span superstructure moved about 25 cm toward upstream. ・The both abutments moved about 15 cm toward river with collapse of abutment parapets. ・The right side abutment's pile tops damaged and main wall cracked into 3 pieces.	・The tremor was extremely severe since the bridge locates on soft ground. ・Anchor bolts fixed the superstructures with the substructures were be too weak. ・Lack of stopper which prevent the superstructure from falling. ・Piles strength was inadequate.	・The gaps on the bridge deck are obstructing traffic. ・The damaged abutments cannot support the superstructures when an earthquake comes.
Nou A Bridge Sta. 0.6 km 1-span Truss type L=51m	・The truss moved about 60 cm toward downstream and fallen from its rubber bearings at the right side abutment. ・The left side abutment moved toward river and its parapet was damaged. ・The bridge width is 4.5m single lane.	・Same as above.	・The remaining truss may fall when an earthquake comes. ・The roads connected with the bridge are used for one-way traffic since the bridge is one-lane width, which is causing traffic congestion at Nou Bridge.
Gido Si'ite Bridge Sta. 20.3 km 2-span RC type L=25+11=26m	・The right side abutment settled about 1 m which caused a gap between bridge and approach road. ・The superstructure moved about 45 cm toward downstream. ・The left side abutment's pile tops were damaged.	・The tremor of the earthquakes was extremely severe. ・Anchor bolts fixed the superstructures with substructures were too weak. ・Lack of stopper which prevent the superstructure from falling. ・Piles strength was inadequate.	・The big gap between bridge and approach road is obstructing traffic. ・The bridge foundations are unreliable and the bridge may collapse totally when an earthquake comes.
Idano Gawo Bridge Sta.36.2 km RC Box + 2-span Truss + RC box type L=12+60+60+12 =166m	・A temporary bailey bridge was installed because the right side box culvert overturned and one span truss has fallen. ・A pier coping cracked and stem slanted toward upstream. The remaining one span truss was sloped due to the slant of the pier.	・The right side box culvert had been scoured by floods then it was overturned by the earthquakes. ・The overturn of the box culvert led the fall of the truss. ・The slant of the pier caused by imbalanced load acted when falling of the truss and inadequate stability of the spread footing foundation which had been scoured by floods.	・The pier is unreliable because the coping is cracked and the stem is slanted. ・The temporary bailey bridge is weak and obstructing traffic.
Mezaya Bridge Sta.87.5 km 3-span Truss type L=3x30.6=92.0m	・The pier footing was scored. ・The pier was slanted by the earthquake. (It stands straight now.) ・The truss is 4.5 m single lane. ・The deck slab is made of timber which is obstructing the traffic and requiring frequent repair.	・The foundation of the pier is shallow caisson type which is easy to be scoured since the embedded depth is not deep.	・The pier foundation is unstable. ・The single lane width and wooden deck are obstructing traffic.
Sa'ua Bridge Sta.101 km Bayley L=61m	・The bridge is temporary bailey. ・The deck slab is made of timbers. ・The bailey is dilapidated and temporary supported with coconut timber piles. ・	・The bridge is totally dilapidated.	・Traffic through the bridge is unsafe due to weak temporary bridge with timber slab. ・Heavy truck cannot pass the bridge.

1.2 NATURAL CONDITIONS

(1) Climate

Nias Island belongs to tropical rainforest climate. The rainfall is not much different in rainy seasons and dry seasons. There is only one weather station in Binaka Airport in Nias Island. The weather data of temperature, rainfall, humidity, wind velocity and wind direction recorded there since 1985 are available. The monthly average temperature and rainfall from 2002 to 2006 are as shown in Table 1.2-1.

Table 1.2-1 Weather Data (Binaka Airport, Gunung Sitoli)

Month	Average Temperature (°C)				
Year	2002	2003	2004	2005	2006
Jan.	26.4	26.1	26.7	26.4	25.7
Feb.	26.6	26.3	26.1	27.0	26.5
Mar.	26.4	26.4	26.3	26.7	26.1
Apr.	26.7	26.5	26.6	26.8	26.0
May	26.7	26.1	26.2	26.6	26.3
Jun	26.1	26.5	25.7	26.2	26.2
Jul	25.8	25.2	25.5	25.8	25.6
Aug.	25.8	25.6	25.4	25.7	25.6
Sep.	25.6	25.4	25.5	25.7	25.3
Oct.	25.7	25.5	25.9	25.3	25.5
Nov.	25.7	25.6	26.0	25.2	26.1
Dec.	26.3	25.5	25.8	25.1	26.5
Month	Rainfall (mm)				
Year	2002	2003	2004	2005	2006
Jan.	448	284	275	163	217
Feb.	146	180	209	52	210
Mar.	218	283	225	209	179
Apr.	124	323	203	107	302
May	279	207	129	195	81
Jun	180	137	215	206	217
Jul	218	252	198	168	202
Aug.	189	313	189	221	250
Sep.	206	315	433	255	275
Oct.	347	360	277	595	318
Nov.	381	364	313	344	235
Dec.	341	269	305	290	234
Total	3,077	3,288	2,972	2,805	2,720

(2) Hydrology

Rainfall intensities (mm/day) were derived from an analysis using “Gumbel Method” on the basis of the rainfall data in last 20 years obtained from the Binaka Airport Weather Station. The rainfall intensities verses return periods are shown on Table 1.2-2.

Table 1.2-2 Rainfall Intensity (mm/day)

Return period (year)	Probale Rainfall (mm/day)	
	Log-Normal Distribution	Gumbel's Method
10	131	145
20	145	165
30	153	177
40	158	185
50	163	191
100	176	211

The calculation of peak discharges of the Project bridge site are shown in Table 1.2-3.

Table 1.2-3 Calculation of Peak Discharges of the Project Bridge Site

No.	1	2	3	4	5	6	Remarks
BRIDGE	Nou	Nou A	Gido Si'ite	Idano Gawo	Mezaya	Saua	
Watershed A (km2)	40.7	40.7	23.4	91.7	77.4	48.2	
Watercourse L (km)	11.8	11.8	10.5	15.6	12.7	16.1	
Diference of Elv. (H)	300	300	270	480	400	320	
Average Slope	0.0254	0.0254	0.0257	0.0308	0.0315	0.0199	
Time of concentration							
Kraven Formula (min.)	56	56	50	74	60	77	empirical formula
Uniform-flow Velocity Formua (min)	109	109	98	125	104	160	
Kadoya's Formula (min)	126	126	108	160	152	152	
Adopted tc (min)	**110**	**110**	**100**	**140**	**120**	**150**	rounded to 10 min.
Rainfall intensity (Mononobe's Formula)							R24= 191mm/day
r (mm/hr) =	44.2	44.2	47.1	37.6	41.7	35.9	
Peak Discharge Qp (m3/s) = 1/3.6·f·r·A							Rational formula
Runoff Factor f =	0.8	0.8	0.8	0.8	0.8	0.8	revers in mountanious district
Qp (m3/sec) =	400	400	245	766	717	385	

(3) Geography/Geology

Nias Island is located 125 kilometers west off the shore of Sumatra Island and is under the jurisdiction of North Sumatra Provincial Government. The island has an area of about 5,625 sq. km and a population of about 730,000. Mountain chains run from east to west of the island of which peak exceeds 2,000 m from the sea level. The east coast of the island is swampy land covered by mangrove trees. Nias Island is geographically suitable for surfing since the island is surrounded by the deep-sea.

Nias Island is located on Indo-Eurasia tectonic plate. Subduction of Indo-Australia tectonic plate under the Indo-Eurasia tectonic plate at west off Nias Island formed Sunda Trench and the archipelago including Nias. Such tectonic activities cut and bend the plates, causing earthquakes in the area.

The geology of the Project bridge sites are shown in Table 2.2-8 in Chapter 2.

(4) Traffic Condition

Traffic count survey was conducted at the Project bridge sites. The traffic volume at the Project bridge is shown on Table 1.2-4.

Table 1.2-4 Traffic Volume of the Project Bridge Sites

Survey Station	Date (2008年)	Direction	Pedes-trian	Bicycle	Motor Bike	Car	Pick up	Light Truck	Light Bus	Large Bus	Truck (>5ton)	AADT (Veh./day)
Nou	26-Feb	To South	1640	2053	14358	628	332	31	0	3	0	17,227
		To North	1568	3503	15987	729	804	465	10	2	14	
Nou A	26-Feb	To South	238	2099	3217	126	512	377	12	0	10	3,371
		To North	254	189	384	8	0	0	0	0	0	
Gido Si'ite	22-Feb	To South	84	186	1382	63	260	86	1	0	46	2,578
		To North	90	193	1606	68	218	91	0	5	61	
Idano Gawo	21-Feb	To South	254	100	852	80	133	102	1	0	45	1,815
		To North	338	104	878	64	144	94	2	1	62	
Mezaya	19-Feb	To South	178	58	444	58	146	48	2	1	3	1,232
		To North	317	116	520	41	141	115	5	0	15	
Sa'ua	18-Feb	To South	200	228	943	34	146	78	0	1	30	1,619
		To North	154	128	748	44	152	92	9	0	25	
	PCU rate		-	0.2	0.3	1	1	1	1	2	2	

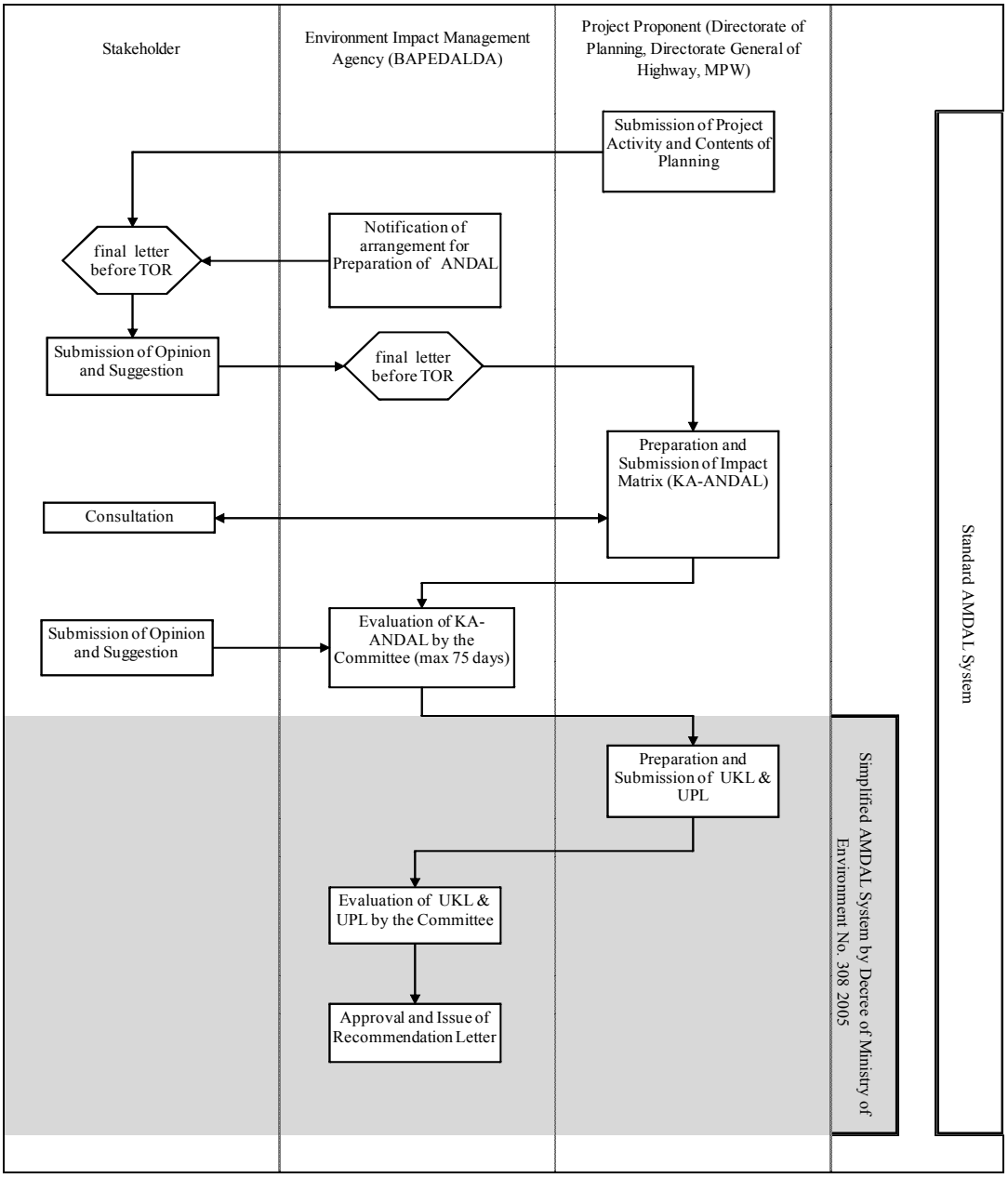
Note: Figures in the table are 12 hour (6:00-18:00) survey data. AADTs are PCU (passenger car unit converted) for both directions for 24 hour (1.3 time of 12 hours).

1.3 ENVIRONMETNAL AND SOCIAL CONSIDERATIONS

(1) Environmental Impact Assessment System (AMDAL)

The standard procedure of the environmental impact assessment system (AMDAL) is shown in Table 1.3-1. To expedite the restoration of disaster by the earthquakes and tsunami in Aceh and Nias, a simplified AMDAL system was introduced by Decree of Ministry of Environment No. 308 in 2005. The simplified AMDAL is applicable to this Project and Environmental Management Plan (UKL) and Environmental Monitoring Plan (UPL) are required to submit to the Environmental Impact Management Agency (BAPEDALDA) in Medan. The Directorate General of Highways of the Ministry of Public Works, the Project implementation agency, is responsible to prepare and submit the UKL and UPL.

Table 1.3-1 Environmental Impact Assessment System (AMDAL)

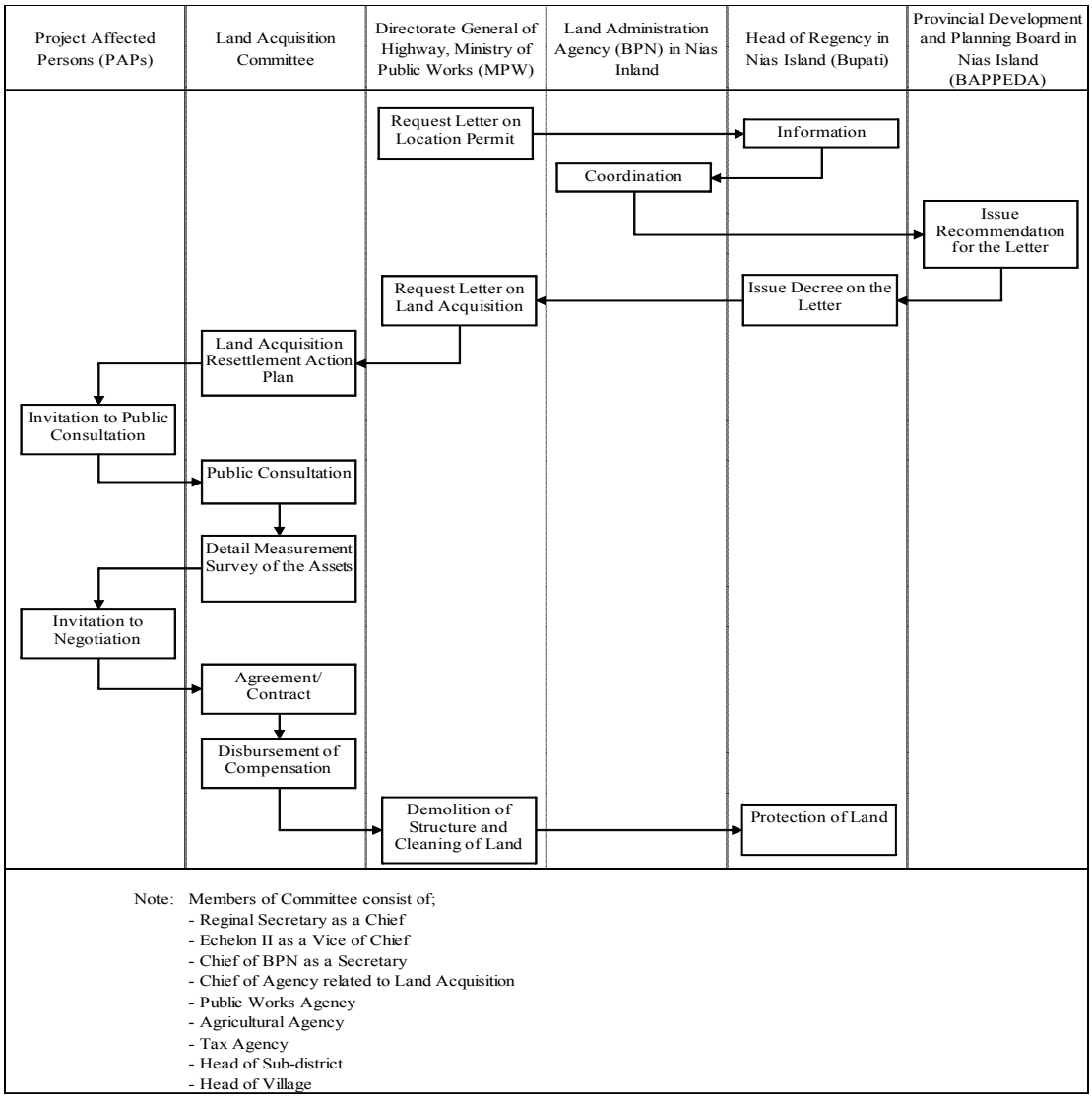


(2) Land Acquisition

The basic laws for land acquisition and compensation has been constituted in the Presidential Degree No.55 issued in May 1993, and the procedure of land acquisition, public hearing, determination of compensation price, application of objection have been regulated in Practical Rule issued in 1994. The road right-of-way (ROW) of the provincial roads are 12 m and regency roads are 8.5m for each side from the center of the road is regulated by the local governments. However, if the ROW has not yet been clearly established anywhere, the government admits the ownership of the land within the ROW which have been resided for more than 20 years, and compensates for the cases of land acquisition for constructions. Therefore, illegally occupied land within the ROW for less than 20 years will never be

compensated by the government but compensation is made only for houses, trees, wells and other properties when necessary to be removed for constructions. The land acquisition for the Project should be started after the signing of the Exchange Note of the Project and should be completed before the commencement of the construction. The procedure of the land acquisition is shown on Table 1.3-2.

Table 1.3-2 Procedure of Land Acquisition



CHAPTER 2 CONTENTS OF THE PROJECT

2.1 BASIC CONCEPT OF THE PROJECT

2.1.1 Overall Goal and Project Purpose

Overall Goal and Project Purpose

Nias Island was severely stricken by two huge earthquakes, the north Sumatra offing earthquake in December 2004 and the northern Nias offing earthquake in March 2005. Some 2,000 people were reported to have been killed in the island. The road was totally damaged by embankment collapse, slope failure and ground flow caused by liquefaction. As for bridges, damage of pile heads, inclination of piers and abutments caused by ground settlement and flow, while abutment slant along with superstructure collapse took place here and there to a large extent.

The Government of Indonesia has established the BRR (Badan Rehabilitasi dan Rekonstruksi Aceh dan Nias = Rehabilitation and Reconstruction Agency of Aceh and Nias) under BAPPENAS' initiative to realize the master plan for the restoration of Aceh Province and Nias Island, and promoted the restoration programs involving aids from the international financial institutions and NGOs. The restoration programs comprise four pillars as follows: (1) Reconstruction of houses and communities, (2) Recovery of infrastructures, (3) Development of local economy and (4) Capacity development. The BRR has been leading the restoration programs by restoration of houses, markets, water supply, sewerage, irrigation, airport, ports, roads, bridges, communication and electric power stations and other facilities in Aceh Province and Nias Island.

This bridge project aims to support the above restoration programs by improving the bridges damaged by the earthquakes and too dangerous for the traffic. The bridges proposed for Japan's grant aid require high constructional technique that is difficult for locally common technique to construct.

Outline of the Project

This project is to reconstruct the following 6 bridges damaged by the earthquakes and currently unreliable.

- Nou bridge (at Sta 0.6 km along Provincial Road No. 75 in Gunung Sitoli City)
- Nou A bridge (at Regency Road in Gunung Sitoli City)
- Gido Si'ite bridge (at 20.2 km along Provincial Road No. 75)
- Idano Gawo bridge (at 36.3 km along Provincial Road No. 75)

- Mezaya bridge (at 87.5 km along Provincial Road No. 75)
- Sa'ua bridge (at 101.0 km along Provincial Road No. 75)

The implementation of this project is to ensure the safety and smooth traffic along the Provincial Road No.75 which serves as the most important trunk road in the island. It will help promoting and restoring the economic development of the island, and it will additionally function as the evacuation and rescue route in case of disasters in the future.

2.1.2 Basic Concept of the Project

Scope of the Japanese Assistance

The scope of the Japanese assistance covers the following works:

- Removal of existing bridges (if necessary for the new bridge construction).
- Construction of bridge structures.
- Approach roads (Minimal length to connect the new bridge with the existing road).
- Abutment protections, riverbank protections, scouring protections (Minimal areas to protect the new bridges).
- Installation of detour bridges (if necessary for the new bridge construction).

Consideration for Natural Conditions

In the bridge planning and designing, the natural site conditions such as topographical condition, geological condition, river condition, seismic condition are taken into consideration. The design flood levels are determined by comparison between the flood levels obtained from hearing / observation survey and from hydraulic analysis with 50-year period probability. The bridge structure should be seismic-resistant since the site is a prone area potential for earthquake.

Consideration for Socio-economic condition

The bridge width and design load are determined by taking the present and future traffic volume and traffic composition into consideration. The road width, the pavement structures and the geometric standards of the bridge approach roads are designed by taking the traffic condition of the sites into consideration.

Consideration for Construction and Procurement Conditions

Local materials and local products are utilized at optimum. Materials are selected by comparing their quality, cost and procurement possibility. Efficient construction plan is prepared by taking the availability of local materials, machines, labors, and so on into consideration.

Operation and Maintenance Policy

After the completion of project, Nou A Bridge will be taken-over by Nias Regency and the other 5 bridges will be taken-over by North Sumatra Province. Then bridge will be maintained under the local government's road and bridge maintenance system. However, the bridge is designed to be maintenance-free as much as possible.

Policy on Facilities Grading

The grading (standards) of the bridges and approach roads are determined referring to the design standards / criteria established by the Ministry of Public Works of Indonesia, of which the standards for provincial roads are basically adopted. However, the design standards proposed for the facilities are clarified for their appropriateness by referring to the Japanese design standards and AASHTO.

Also, the design standards adopted in the projects of BRR, IREP (Infrastructure Reconstruction Enabling Program) and other donors are referred to.

Policy on Construction Method Planning

To plan the construction easily and smoothly, the common construction methods using common materials and technique in Indonesia and Japan are adopted. To secure the construction quality, the required specifications of the material quality tests and as-built measurement inspection are clearly written in the contract documents and technical specifications. The construction plan is prepared by taking safety of the surrounding residents and construction staff and environment into considerations. Detour roads/bridges are provided during the construction.

Policy on Environmental and Social Consideration

As this project is to reconstruct existing bridges, therefore, it will not change the natural environment conditions. However, the followings are considered in the design and construction planning to minimize the effects on the environmental and social conditions.

- Complying to the environmental law and regulations to obtain the construction permit
- Avoiding land acquisition and removal of houses in selection of new bridge location
- Minimizing relocation of utilities and obstacles in road alignment planning
- Minimizing the inconvenience for traffic by providing temporary detour bridges
- Controlling vibration and noise in the vicinity of residential area
- Treating the construction disposals properly

Policy on Cost Efficiency

The bridge facilities will be designed with the top priority to secure the required functions and durability. However, cost efficiency will also be considered in the design. The major items to

be considered are as follows:

- Materials are selected on cost comparison including local materials.
- Construction methods are proposed on cost comparison of schemes including utilizing local materials and equipments.
- The facility capacity is determined in anticipation to the present and future use.
- Materials for protections, retaining walls, ditches should be from economic and locally available materials.
- Coordination and consistency with other donor projects are taken into considerations.
- Up-to-date design method is adopted in structural design.

2.1.3 Environmental and Social Consideration

(1) Environmental Compliance Certificate

Environmental Management Plan (UKL) and Environmental Monitoring Plan (UPL) are required for the implementation of this project. The UKL and UPL were prepared by the Directorate General of Highways of the Ministry of Public Works and then submitted to the North Sumatra Regional Environmental Impact Management Agency (BAPEDALDA). BAPEDALDA evaluated the UKL & UPL and then issued the Recommendation for the implementation of the project on June 24, 2008. The recommendation declares the permission to undertake the works, requirement to comply to Environmental Management System and report the implementation of UKL & UPL to BAPEDALDA at least every 6 months and others. The major contents of the UKL & UPL and the recommendation are described in Table 2.2-11 and 12 in Section 2.2.4.2 Implementation Conditions.

(2) Land Acquisition and Resettlement

The land acquisition and resettlement will be implemented by the Land Acquisition Committee headed by the Bupati (Mayor) of the regency. The Regency Government together with the Directorate General of Highways of the Ministry of Public Works conducted public hearings/stakeholder meetings in April 2008 and confirmed the project affected persons (PAPs) consent for the land acquisition and resettlement for the project. The outline of the public hearing / stakeholder meeting is shown in Table 2.1-1. The minutes of the public consultation / stakeholder meetings are shown in Appendix 6.

Table 2.1-1 Outline of Public Hearing/Stakeholder Meeting

Venue: Regional Development Office, Nias Regency (April 9, 2008)
Mezaya and Sa'ua bridge site, South Nias Regency (April 10, 2008)

Attendee: - Ministry of Public Works: Directorate General of Highway Planning Office
- Nias and South Nias Regency: Regional Development Office, Public Works Office, Traffic Control Office
- Representatives of project site: District Mayors, Village Chiefs, Residents of the site, PAPs (affected land owners and house owners)

Discussion Topics:
- Explanation of the project contents
- Affected areas of land acquisition and resettlement and their compensation method
- Confirmation of consent for the project

Comments: - Request of employment from the site area for the project construction
- Request of procurement of local materials (aggregate, etc.)
- Request not to cause vibration and noise near residences
- Request of compensations for relocation of houses and stores in order to install temporary bridges, if necessary
- Request of detail explanation when the project starts

On signing of Exchange of Notes (E/N) for the implementation of the project, the land acquisition and resettlement will be executed. The land acquisition and resettlement should be completed before the start of construction. Land acquisition and resettlement necessary for this Project is summarized in Table 2.1-2. The Locations of the land acquisition and resettlement are shown on Figure 2.2-7.

Table 2.1-2 Land Acquisition and Resettlement Necessary for the Project

	Land Acquisition(m2)	Resettlement (House)
Nou Bridge	30	-
Nou A Bridge	30	1 (Temporary house)
Gido Si'ite Bridge	1,000	-
Idano Gawo Bridge	-	-
Mezaya Bridge	80	2 (One is foundation only)
Sa'ua Bridge	-	-

(3) Environmental and Social Considerations

Probable negative impacts due to the implementation of the project which were mentioned in the preliminary study of the project and their mitigation measures are as shown on Table 2.1-3.

Table 2.1-3 Probable Negative Impacts and Mitigation Measures

Environmental Item (Affected Term)	Negative Impact	Counter measure/Mitigation measure
Involuntary Resettlement (long-term)	- Resettlement will be necessary due to realignment of bridge approach road.	- Alignment is examined to minimize resettlement.
Air Pollution (short-term)	- Dust and smoke will come out from asphalt plant. - Exhaust smoke from construction equipment will pollute air.	- Asphalt plant is installed away from residential area. - Checking up of equipment is made frequently to maintain equipment in good condition.
Water Pollution (short-term)	- River will be muddy due to excavation in the river.	- Excavation area is closed with coffer dam. - Muddy water is cleaned in deposit.
Noise and Vibration (short-term)	- Noise and vibration will reach residential areas.	- Silent and low vibration type equipment is used. - Equipment is well maintained by frequent check up. - Works are suspended on holidays and local off days.

2.2 BASIC DESIGN OF THE REQUESTED JAPANESE ASSISTANCE

2.2.1 Design Standards and Criteria

(1) Design Standard

The design specifications issued by the Directorate General of Highway, Ministry of Public Works, Indonesia are basically adopted for the design of bridges and approach roads. These design specifications are similar to the specification of Australian, Japanese and AASHTO. Supplementary, Japanese Specifications and AASHTO's are applied for the design.

(2) Bridge width

Traffic volume on the project bridges

Present and 10-year after traffic volume estimate (Passenger Car Unit) of the project bridge site is shown on Table 2.2-1.

Table 2.2-1 Present and Forecasted Traffic Volume (PCU／day)

	2008	2018
Nou Bridge	17,227	22,170
Nou A Bridge	3,271	10,788
Gido Si'ite Bridge	2,578	4,125
Idano Gawa Bridge	1,815	2,903
Mezaya Bridge	1,232	1,972
Sa'ua Bridge	1,619	2,591

Note) Future traffic volumes were forecasted on the basis of the following assumptions:
- Traffic increase rate is 5% annually.
- Nou A bridge traffic will increase to be doubled after the bridge opening with two-way traffic. On the other hand, traffic at Nou Bridge will decrease.
- It is possible that the traffic would not increase as forecasted above since the present traffic comprise many recovery project vehicles and the BRR office in Gunung Sitoli will close down in 2009.

The peak hour traffic volume (PCU) at Nou bridge is shown on Table 2.2-2.

Table 2.2-2 Peak Hour Traffic Volume at Nou bridge (PCU)

Peak time	2008	2018
07:15 – 08:15	1,310	2,096
12:00 – 13:00	1,272	2,035
17:00 – 18:00	1,314	2,102

Bridge Width Adequacy

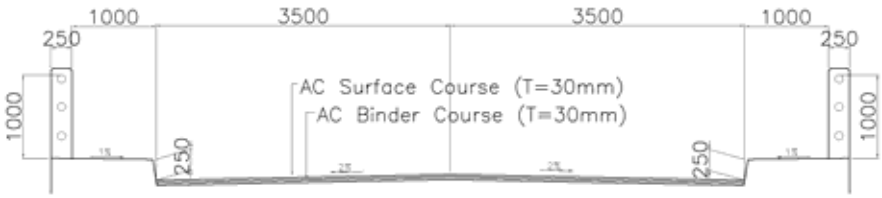
The Road Geometric Standard of the Japan Road Association specifies that 2-lane is adequate

for the roads with the following traffic volumes or less.

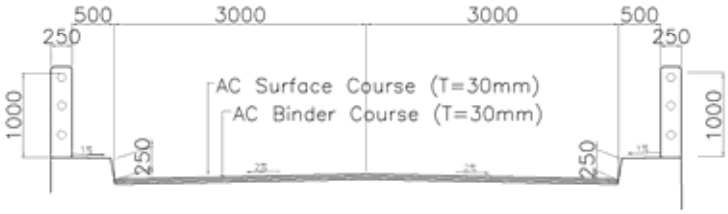
- Rural Road：6,000～8,000/day
- Urban Road：9,000～10,000/day

Based on the above, 2-lane width is adequate for the 5 bridges except for Nou Bridge. A 6m width with 2-lane carriageway is proposed for the 5 bridges located on the Provincial Road No. 75 since all the existing bridges along Provincial Road No. 75 are 6m wide and bridges planned by other donor project are designed with 6 m wide as well.

On the other hand, Nou bridge of which forecasted traffic in 2008 (22,170 PCU/day) is much larger than 2-lane urban road capacity (10,000 PCU/day), while the forecasted peak hour traffic in 2018 (2,102 PCU/hr) is less than 2-lane road peak hour traffic capacity (2,500 PCU/hr) which is indicated in the Highway Capacity Manual of Japanese Road Association and AASHTO, therefore, 2-lane width is adequate for Nou Bridge. Providing an additional slow-vehicle lane will be better because traffic congestions occur during peak hours due to slow vehicles such as manual becaks (tricycles) and motor-becaks (motor-tricycles) which are mixed up in the traffic flow. However, widening of the present bridge approach roads, which are 9 m wide, is difficult because the roads are supported by retaining walls and there are many houses along the walls. Totally 9 m wide bridge is proposed to maintain the road width consistency in the bridge and the approach sections. To provide space for a heavy traffic of pedestrians, 1 m wide sidewalk for each side is proposed. Consequently, the remaining 7 m wide will be allocated for the carriageway of Nou Bridge. In this bridge width component, small motor-vehicles (cars and pick-ups) may overtake slow vehicles since the small motor-vehicles are around 1.7 m wide while slow vehicles are around 1.4 m wide. The traffic congestion at Nou Bridge is expected to be mitigated since the carriageway will be widened from 6 m to 7 m, and the traffic volume will be reduced by widening of Nou A Bridge which is presently 4.5 m wide with single lane becomes 6 m wide with 2-lane. The proposed width composition of the project bridges is shown on Figure 2.2-1.



Nou Bridge



Other bridges

Figure 2.2-1 Proposed Width Composition of Project Bridges

(3) Design Live Loads

Most of the heavy vehicles are 6 or 8 ton capacity small tracks in Nias Island. There are few 20 ton large trucks belonging to recovery projects. The road width in Nias Island was mostly only 4.5 m and there were many weak temporary bridges. It seems to be the reason why there are only a few heavy trucks. According to the Governments of North Sumatra Province and Nias Regency, there is no stipulating regulation that bans heavy vehicles. It is expected that heavy vehicles will increase in Nias Island when roads are widened and temporary bridges are replaced with permanent structures by recovery projects. The same to the other donor's bridge project, the design live loads specified in the bridge design specifications issued by Directorate General of Highways of the Ministry of Public Works is used for the design of the project bridges.

(4) Design Seismic Load

Ministry of Public Works of Indonesia issued seismic design guidelines for bridges. The contents of the guidelines are similar to the seismic guidelines of Australia, Japan and USA. The latest seismic design guidelines were issued in 2005 which was prepared before the huge Sumatra offing earthquakes. In the guidelines, 500-year return period seismic load by area is given as the design seismic load. Acceleration 0.46 - 0.50 g at bearing strata or 0.21 (for medium hard soil) static seismic coefficient is the design seismic load for the area covering Nias Island.

It was reported that the earthquakes occurred at Sumatera offing on December 26, 2004, and on March 28, 2005 are at magnitude 9.1 and 8.6 respectively. The magnitude is the biggest

ever in the world. The design seismic load for this project should be reviewed and established considering these earthquakes occurred in the same situation as the Japanese seismic design code has been revised after Kanto Earthquake and Kobe Earthquake. However, the present seismic design guidelines are used for the design of the project bridges on the following reasons:

- Directorate General of highway, Ministry of Public Works has not so far revised the seismic design guidelines up to now.
- Present bridge seismic design guidelines are applied by the other donor bridge projects, therefore, it would be inconsistent for the bridge design in Nias in case this project uses a revised design seismic load.
- In order to review and establish a new design seismic load considering the late big earthquakes, seismic records, seismic analysis experts and bridge seismic design experts are required, but they are not available in this basic design study.
- The magnitudes of the earthquakes were very big; however, it is unclear whether the actual seismic movement in Nias exceeded the design seismic load. According to earthquake disaster reports, the major cause of the bridge failures are lack of reliable devices to prevent bridges from falling, structural weakness due to poor work quality and liquefaction was not considered.
- The present bridge seismic design guidelines in Indonesia are not substandard compared to the other bridge seismic design codes/specifications in other earthquake prone countries such as Japan, Philippine and USA.

It is proposed for this project to use “Integral type” structures, which seldom collapse even when the ground shakes and moves, and “steel plate girder type” structures which are ductile and able to be deformed without breaking even when the bridges are significantly displaced. The proposed bridges will then become more seismic resistant than the previous types. As the result, it is able to provide reliable transportation means for evacuation and rescue operation in case of future earthquakes, which is the one of main objectives of this project.

(5) Temperature Change

Temperature change：±15℃

(6) Material Specification

Concrete (Design Strength)

- Deck slab: 30 Mpa
- Pier column and coping: 30 Mpa
- Footing and Wall: 24 Mpa
- Bored pile: 30 Mpa

(7) Steel Plates

- For main member and splice: JIS G 3106-SM490Y
- For diaphragm and stiffener: JIS G 3101-SM400
- Other minor members: JIS G 3101-SS400

Steel Materials

- Reinforcing Steel Bars: SD 40 (Min yield point 390 N/mm2)
- High Tensile Bolt: JIS B 1186 F8T (Galvanized)

(8) Bridge Freeboad

Bridge over river without driftwoods：1.0 m （Nou, Nou A, Gido Si'ite and Sa'ua)
Bridge over river with driftwoods：1.5m（Idano Gawo and Mezaya)

Since fishing boats usually pass under Nou Bridge and Nou A Bridge, the bridge soffit elevations should be maintained or raised.

(9) Geometric Standards of Bridge Approach Road

The geometric standard of the bridge approach road is shown on Table 2.2-3.

Table 2.2-3 Geometric Standard of Bridge Approach Road

Terrain	Flat	Hilly	Mountainous	Urban
Design Speed (km/hr)	60	40	30	30
Minimum Radius (m)	110	50	30	30
Maximum Grade (%)	6.0	8.0	10.0	6.0
Pavement Width (m)	6.0	6.0	6.0	6.0 – 7.0
Shoulder Width (m)	1.0	1.0	1.0	1.0 – 1.5

Note: - Widening for curve section is not provided for urban area and small traffic area.
- Super-elevation for curve section is not provided for urban area and slow speed area.

(10) Pavement Structure and Typical Cross Section of Bridge Approach Road

BRR is implementing road improvement work along Provincial Road No. 75 and streets in Gunung Sitoli City. The pavement structure of BRR project is adopted for this project bridge approach roads. The bridge deck is paved with 2-layers of 3 cm thick asphalt concrete. The typical cross section of the bridge approach roads is shown in Figure 2.2-2.

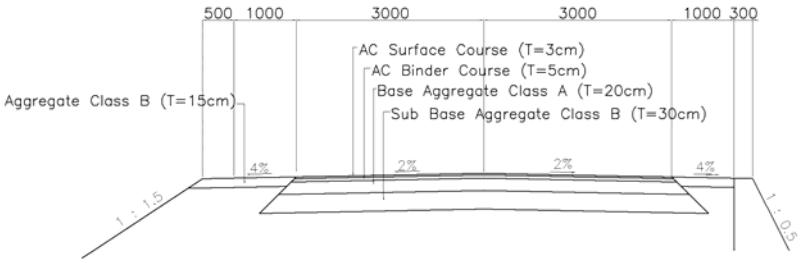


Figure 2.2-2 Pavement structure for approach road

2.2.2 Basic Design

2.2.2.1 Bridge Structures

(1) Superstructure Type

Common superstructure types with their features and applications are shown on Table 2.2-4. Steel plate girder type is proposed for all of this project bridges on the following reasons.

- Seismic resistant type is required because Nias Island is prone to earthquake. Steel girder type is desirable for its lighter weight and more seismic resistance than concrete girder type. Also, steel girder is reparable since it is easy to be jacked up and welded.
- There is no difficulty in procurement of steel girders since there are some 10 steel girder manufacturers in Jakarta and steel girders will be delivered to the site around 3 months from the order date. Galvanized steel girders do not require repainting for many years.
- PC girders need a wide yard for their fabrication, while no wide space is available in Gunung Sitoli City and other bridge sites. In addition, it is difficult to acquire working space for heavy equipment to launch PC girders and also difficult to transport heavy cranes to the sites along the zigzagging and steeply slanting roads.
- Fabrication of PC girder needs high strength concrete, while high strength concrete may not be available since the only available gravel from Idano Gawo River contains soft rocks.
- PC girder is long and heavy while steel plate girder can be cut into small pieces. Therefore, hauling and erection of girders are easier and safer.

(2) Seismic Resistant Structure

The following structures are introduced for the project bridges to be seismic resistant.

- Light and ductile steel plate girders are used for the superstructure.
- Integral type (abutments and piers are rigidly connected with superstructure) is adopted.
- Flexible 2-column type pier is adopted instead of ridged wall or oval type pier. Flexible 2-column pier can stand without collapse under excessive earthquake by forming plastic

hinges at the top of the columns which may absorb the seismic energy.
- Extraordinary earthquakes may damage bridges. However, damages above ground may be repairable.
- Possibility of liquefaction is examined from the result of sieve analysis of the sub-surface soil samples. The bridge foundation is designed with reduced soil strength where soil is subject to liquefaction.

(3) Maintenance-Free Structure

The following measures are introduced for the project bridges to minimize maintenance.

- Expansion joints and bearings which needs frequent maintenance are not necessary for the integral type bridge.
- Galvanized (Zink hot dip galvanized) steel is free from repainting for 30 to 40 years.
- Deck slab is paved with asphalt concrete.
- Adequate length (5m) approach slab is installed.
- The revetment and erosion protection are durable type.

(4) Counter-measure for Salt Water

Nou Bridge, Nou A Bridge, Mezaya Bridge and Sa'ua Bridge are located seaside. The following counter-measures are taken against salty water.

- Reinforcing bars are protected by increased concrete covers depends on the member's exposure level to salty water.
- Sa'ua Bridge is located near a beach with severe waves. Therefore, epoxy resin paint is planned to be coated on the galvanized steel members.

(5) Foundation Type

Common foundation type with their features and applications are shown on Table 2.2-5.

(6) Revetment and Abutment Protection Type

Common revetment and abutment protection type with their features and applications are shown on Table 2.2-6.

(7) Cost Efficiency

The measures to be cost efficiency are as follows:

<u>Adoption of Integral Bridge Type</u>
- Footings are not necessary

- Pile quantity can be reduced.
- Cofferdam temporary work is not necessary because no need to construct footings
- Bridge expansion joints and bearings are not necessary.
- The steel girders section can be smaller than simple supported steel girders.

Low Cost Structure

- Railing is simple type.
- Bridge deck drainage pipe is of polyvinyl chloride material instead of steel pipe.
- Bridges are vertically curbed to reduce embankment and pavement.
- Steel materials are galvanized to reduce lifecycle cost.

Procure Local Material

- Steel girders are fabricated in Indonesia, using Indonesian steel plates.

Table 2.2-4 Comparison of Superstructure Type

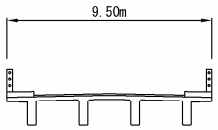
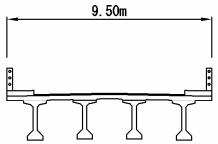
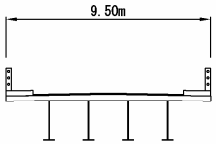
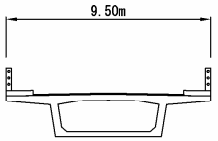
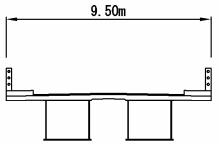
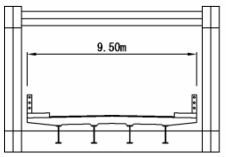
Type	RC Girder	PC Girder	Steel Plate Girder	PC Box Girder	Steel Box Girder	Truss
Section						
Economy span	Less than 18m	15～35m	15m～40m	35m～100m	40m～70m	40m～70m
Construction method	・Install support on the ground and set form and reinforcing bars, then pile deck slab concrete.	・Fabricate PC girders at the yard near the site, then bring it to the site, and launch the girders. ・After setting form and reinforcing bars, place deck slab concrete.	・After fabricating and galvanizing steel members at the factory in Jakarta, deliver them to site through Gunung Sitoli port, then launch the girders. ・After setting form and reinforcing bars, place deck slab concrete.	・Placing concrete for main girder by 2-3m block from pier head, then set longitudinally PC cable after hardening concrete, then extend main girders. ・Set transverse PC cable in deck slab.	・After fabricating and under coat painting steel members at the factory in Jakarta, deliver them to site through Gunung Sitoli Port, then launch the girders. ・After coating at the field paint, set form and reinforcing bars, place deck slab concrete.	・After fabricating and galvanizing steel members at the factory in Jakarta, deliver them to site through Gunung Sitoli Port, then launch the girders. ・After setting form and reinforcing bars, place deck slab concrete.
Construct-ability	・Installation of supports is difficult in case river is deep. ・Construction period is short because girders and slabs can be made only one concrete pouring.	・Special material and equipment and technique for fabricating PC girders are required. ・High strength concrete is necessary for PC girder. ・Special equipment and temporary work are necessary for launching heavy PC girder.	・Launching steel girder is easy because pieces of steel girder are light and small	・Special technique and special equipment are necessary for construction. ・High strength concrete is necessary for PC girder. ・River condition does not affect the work.	・Transportation and launching of box girders are difficult because the box girder is heavy and large.	・Transportation of truss members is easy because it is small and light. But launching is difficult because there are many site connection works and a large range of temporary works because the bridge is heavy.
Construction Period (for super-structure)	・Superstructure total :3 months (30m long bridge case)	・Fabrication of PC Girdrs: 3 months ・Launching+slab:3.5 months ・(30m long bridge case)	・Fabrication of steel girders+ transportation: 4 months ・Launching+slab:2 months (30m long bridge case)	・Superstructure total : 8.5 months （100m bridge case）	・Fabrication of steel box girders + transportation: 5 months ・Launching+slab:3 months (100m long bridge case)	・Fabrication of steel members + transportation: 5 months ・Launching+slab:4 months (100m long bridge case)
Required Maintenance	・Concrete is maintenance- free	・Concrete is maintenance-free	・Galvanized steel is maintenance free	・Concrete is maintenance- free	・Epoxy paint coated steel is maintenance-free.	・Galvanized steel is maintenance free. ・Routine cleaning of dust on lower chord is necessary.
Other Feature	・Integral type is seismic resistant.	・Substructure is large because superstructure is heavy. ・Integral type is not easy to apply for concrete precast girder.	・Substructure is small because superstructure is light ・Integral type is seismic resistant.	・Integral type is seismic resistant. ・Substructure is large because superstructure is heavy.	・Substructure is smaller than concrete because superstructure is lighter than concrete.	・Substructure is large because total bridge width is wide. ・Soffit of the bridge can be higher than other type.

Table 2.2-5 Comparison of Foundation Type

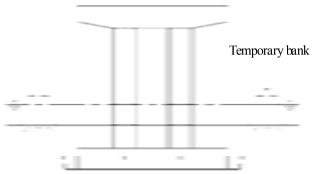
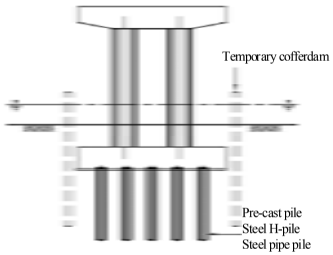
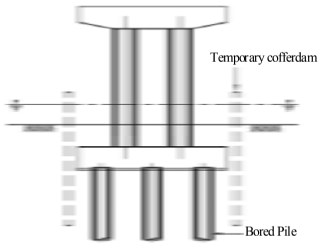
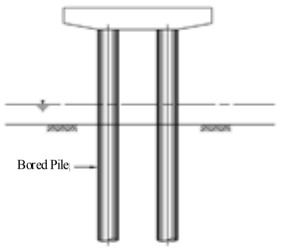
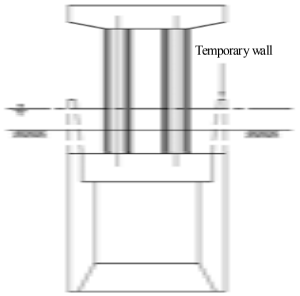
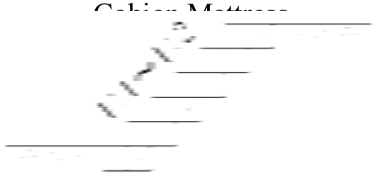
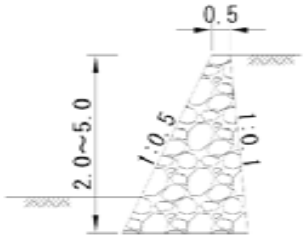
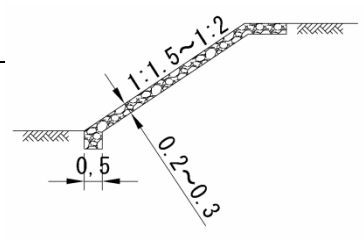
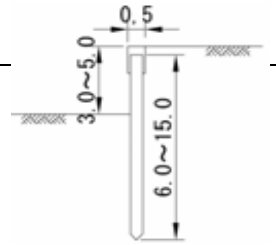
Type	Spread Foundation	Driven Piles Foundation	Bored Pile Foundation (Footing)	Bored Pile (Pile-Bent)	Open Caisson Foundation
Conceptual Figure					
Construction Method	・Excavate ground, then install footing foundation on the ground directly.	・Fabricate pre-cast piles at the site or hauling precast piles from pre-tension factory. In case of H-steel pile or steel pipe pile, order fabrication to the factory in Jakarta, then deliver them to the site. ・Diameter of pre-cast pile and steel H-pile is about 40cm, steel pipe pile is about 60cm. ・After piling, excavate ground, then install footing foundation. ・Place cofferdam by steel sheet pile with pump-up if water level is high.	・Drilling ground using boring equipment, insert cage, place underwater concrete using tremie pipe. ・Diameter of pile is 1.2-1.5m. ・Drilling through boulders or rocks is possible by using hummer grab or rotary casing. ・After pouring pile concrete, excavate ground, then install footing foundation. ・Steel sheet pile coffer dam is necessary if river is deep.	・Method is same as Bored Pile (Footing). Extending pile until pier coping. ・Long stand pipe is used in case river water is deep.	・Fabricate circle or square open caisson on the ground, excavate inside soil with excavator or clamshell, then sink down open caisson up to bearing stratum. If bearing stratum is deep, sink down open caisson with joint. ・Place temporary cofferdam if there is water, remove it after installing footing foundation and piles.
Applicable Soil Condition	・Applicable for bearing stratum (N-value>30) if shallower than 5m from ground level.	・Applicable for ground without boulders. ・Not applicable in residential area because of vibration and noise. ・Maximum pile length of pre-cast pile is about 15m, and maximum pile length of steel H-pile or steel pipe pile is about 50m.	・Applicable for most type of soils.	・Applicable for most types of soils. ・Pile-bent type is applicable only for light superstructure.	・It is possible to excavate even soils with big boulders or hard rocks. ・If bearing stratum is deep, excavation and sinking down of open caisson become difficult, therefore applicable only to shallow bearing stratum.
Equipment/ Constructability	・No need special machine. ・Very easy. ・Draining water is difficult if river is deep.	・Pile driving equipment is larger than bored pile equipment. ・Piling work is easy. ・Confirmation of bearing capacity is easy.	・Drilling equipment is smaller than driven pile equipment. ・Quality control of drilling and concreting are important. ・Bearing capacity test needs special equipment.	・Same as left. ・Construction is easy and simple because construction of footing is not necessary. ・Construction is easy if river water is deep because cofferdam is not necessary.	・Construction is complicated because there are many field works.
Construction Period/ Cost	・Construction period is very short. ・Cost is very cheap.	・Construction period is shorter than bored pile foundation. ・Cost is less than bored pile foundation.	・Construction period is shorter than Cast-in-place pile bending. ・Cost is higher than driven pile.	・Construction period is short and cost is less because construction of footing is not necessary.	・Construction period is long and cost is expensive.
Applicable Bridge	・No bridge site is applicable because bearing strata is deep at all sites.	・Applicable to Gido Si'ite Bridge, but needs comparison with bored pile bent.	・Applicable to all bridges but cost is higher than pile-bent type.	・Applicable to all bridges if structural requirement is satisfied.	・Cost is higher than bored pile.

Table 2.2-6 Comparison of Revetment and Abutment Protection Type

Section				
Material and Equipment	・Cobble stones ・Gabion net	・Cobble stone and concrete ・Concrete mixer	・Cobble stone and mortar	・PC sheet pile ・Pile driver (Vibro-hammer) ・Reinforcing bars for pile cap.
Applicable condition	・Applicable for most site condition. It is flexible and can follow the deformation of ground. ・Not applicable if water is salty.	・Not applicable if ground is soft. ・Not applicable to be located in the water. ・Scouring protection is necessary if scoring is anticipated.	・Applicable for protection of slopes form. ・Scouring protection is necessary if scoring is anticipated.	・Not applicable if ground is hard or boulders exist. ・Piling equipment is necessary. ・Applicable in several meter deep river.
Durability / Required Maintenance	・Gabion net will corrode in many years (10 to 20 years).	・Maintenance-free. ・Maintenance is necessary when scouring or settlement occurs.	・Maintenance-free. ・Maintenance is necessary when scouring or settlement occurs.	・Maintenance-free.

2.2.2.2 Selection of Bridge Locations

New bridge locations are selected by comparing the alternative scheme of locations. The concepts of selection of the bridge locations are as follows. The comparison of the bridge location schemes are shown in Table 2.2-7.

Concepts of selection of bridge location

- Resettlement should be minimized.
- Land acquisition should be minimized.
- Relocation of utilities should be minimized.
- Disturbance to traffic should be minimized.
- Construction cost including temporary works should be minimized.
- Space for temporary bridge and temporary works is available.

Table 2.2-7 (1/6) Comparison of Nou Bridge Location Scheme

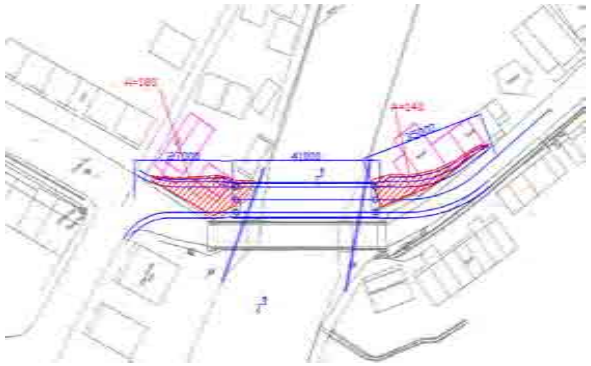
	Plan	No. of Resettle-ment	Land Acquisition Area	Relocation of Utility	Detour Route	Approach road alignment	Removal of existing br.	Cost	Comparison
Scheme 1		Concrete houses:5 (All stores, including 3 row houses)	585 ㎡ (Commer-cial area)	Water pipe×1 (φ 20cm) Tel. pipe×2 (φ 15cm) E. pole×2	Existing bridge	R=30m	After new bridge comple-tion	1.0 Bridge:44m Road:73m (Cost for demolition of existing bridge is not included.)	<u>New bridge at upstream side of existing bridge</u> - Resettlement of stores and land acquisition of commercial area are difficult.
Scheme 2		None	30 ㎡ (River-bank)	Water pipe×2 (φ 20cm) Tel. pipe×2 (φ 15cm)	Nou A Bridge	R=30m	Before new bridge const.	1.0 Bridge:42m Road:48m Demolish Existing bridge.:47m Temporary bridge: 42m	<u>New bridge at existing bridge location</u> - Cost is higher than Scheme 3 in case Scheme 3 excludes cost for demolition of existing bridge. However, no difficulty in land acquisition is anticipated. Selected
Scheme 3		Concrete house:1 Wooden houses:5 (All stores)	320 ㎡ (Commer-cial area)	Water pipe×1 (φ 20cm)	Existing Bridge	R=30m	After new bridge comple-tion	0.95 Bridge:41m Road:62m (Cost for demolition of existing bridge is not included.)	<u>New bridge at downstream side of existing bridge</u> - This scheme cost is the least in case the cost for demolition of existing bridge is not included. However, resettlement of stores and land acquisition of commercial area are difficult.

Table 2.2-7 (2/6) Comparison of Nou A Bridge Location Scheme

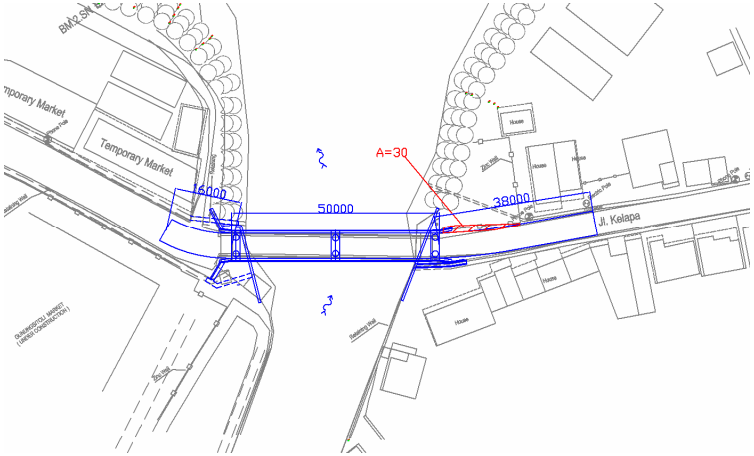
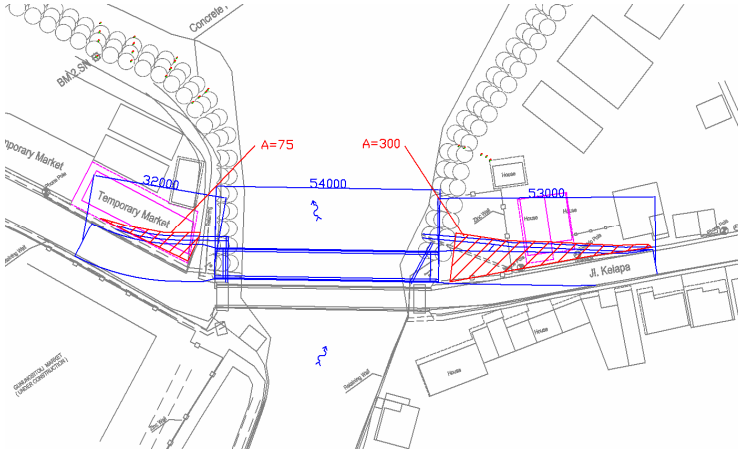
	Plan	No. of Resettle-ment	Land Acquisi-tion Area	Reloca-tion of Utility	Detour Route	Approach road alignment	Removal of existing br.	Cost	Comparison
Scheme 1		Tempo-rary House:1	30 ㎡ (river-bank)	Tel pole×2	Nou bridg	R=30m	Before new bridge const.	1.0 Bridge:50m Road:54m Dmolition of existing br.:51m Temporary br. for light vehicles :54m	New bridge at existing bridge location - Cost is less than Scheme 2. - Resettlement and land acquisition is less than Scheme 2. Selected
Scheme 2		Concrete House:1 Wooden Houses:2 (1 of them is a temporary market)	375 ㎡ (Residentia l area at right bank, public market at left bank)	Tel pole×2	Existing bridge	R=50m	After new bridge comple-tion	1.03 Bridge:54m Road:85m (Not including cost for demolition of existing br.)	New bridge at downstream side of existing bridge ・Cost even without demolition of existing bridge is higher than Scheme 1, and resettlement and land acquisition of commercial area are difficult.

Table 2.2-7 (3/6) Comparison of Gido Si'ite Bridge Location Scheme

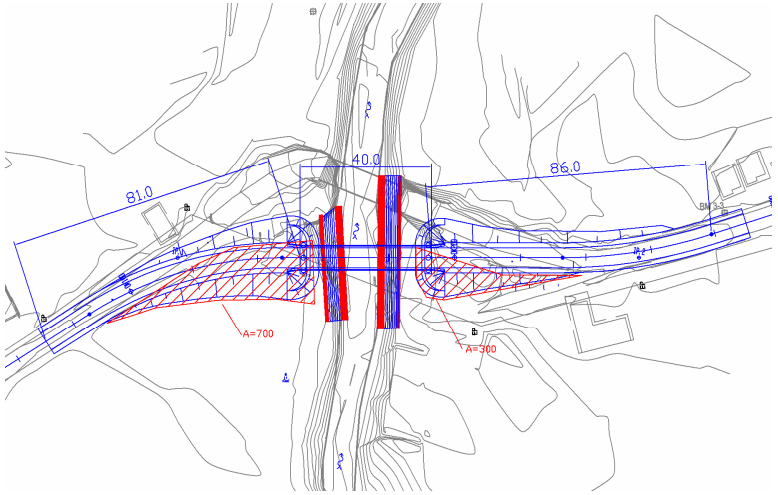
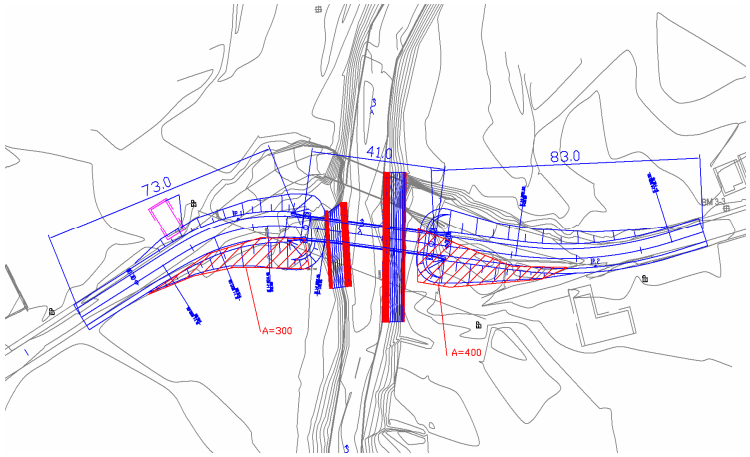
	Plan	No. of Resettle-ment	Land Acquisi-tion Area	Relocation of Utility	Detour Route	Approach road alignment	Removal of existing bridge	Cost	Comparison
Scheme 1		None	1000 ㎡ (Farm)	E. Pole×1 (Relocation of a pole or rising wire by an additional pole.)	Existing Bridge	R=110m	After new bridge completio n	1.0 Bridge:40m Road:167m (Not including cost for demolition of existing bridge)	New bridge at upstream side of existing bridge (Rectangle to river) ・No resettlement is necessary. ・Land acquisition area is larger than scheme 2, however, acquisition of farm is not difficult. ・Alignment is good. Selected
Scheme 2		Wooden House :1	700 ㎡ (Farm)	E. Pole×1 (Relocation of a pole or rising wire by an additional pole.)	Existing Bridge	R=50m	After new bridge comple-tion	1.0 Bidge.:41m Road:156m (Not including cost for demolition of existing bridge)	New br. at upstream side of existing br. (Near to existing bridge) ・Resettlement is necessary.

Table 2.2-7 (4/6) Comparison of Idano Gawo Bridge Location Scheme

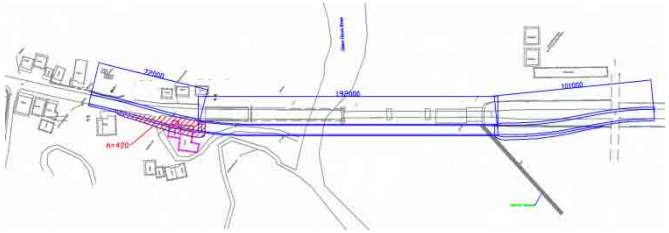
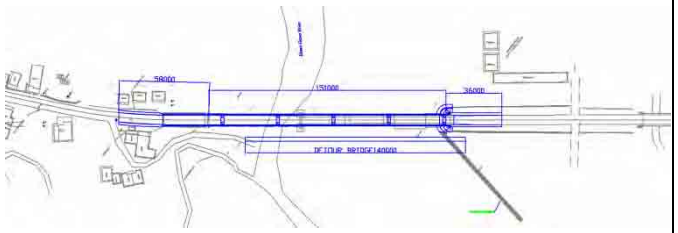
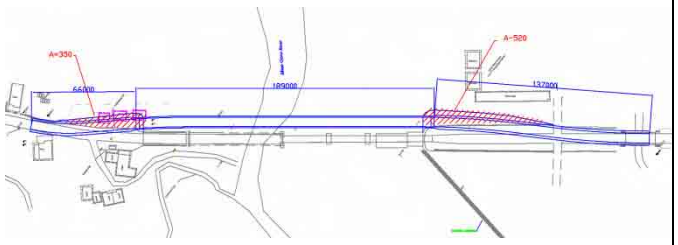
	Plan	No. of Resettle-ment	Land Acquisi-tion Area	Relocation of Utility	Detour Route	Approach road alignment	Removal of existing br.	Cost	Comparison
Scheme 1		Concrete house:1 Wooden house:1	420 ㎡ (Residential area)	None	Existing bridge	R=200m	After new bridge comple-tion	1.2 Bridge:192 m Road:173m (Cost for demoli-tion of existing bridge is not included.)	New bridge at upstream side of existing bridge -Resettlement and land acquisition are necessary. -Cost is higher than scheme 2.
Scheme 2		None	None	None	Temporary bridge	Straight	Before construc-tion of new bridge	1.0 Bridge:151 m Road : 94m Removal of existing br.:151m Tempo-rary br.:140m	New bridge at existing bridge location -Cost is the lowest, and resettlement and land acquisition are not necessary. Selected
Scheme 3		Concrete house:3	870 ㎡ (Left side is residence area. Right side is riverbank)	E. Pole×2	Existing bridge	R=110m	After new bridge comple-tion	1.2 Bridge:189 m Road:203m (Cost for demoli-tion of existing bridge is not included.)	New bridge at downstream of existing bridge -Resettlement and land acquisition are necessary. -Cost is higher than scheme 2.

Table 2.2-7 (5/6) Comparison of Mezaya Bridge Location Scheme

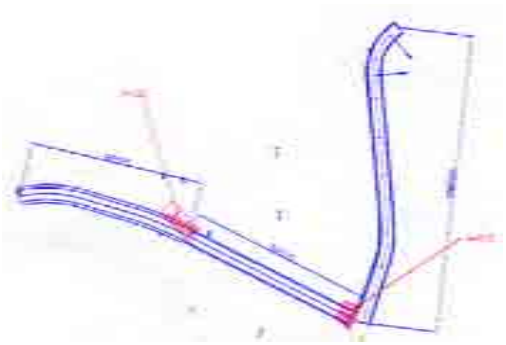
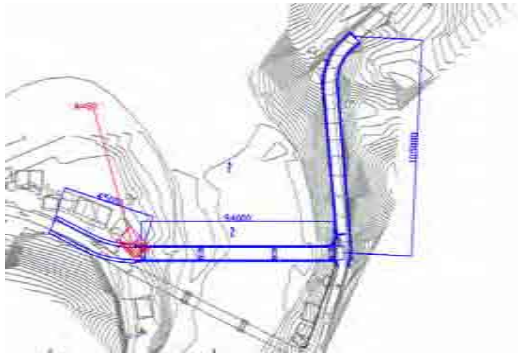
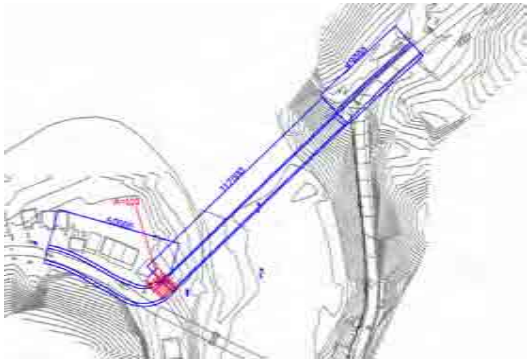
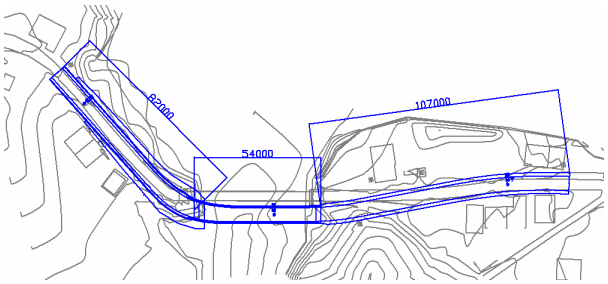
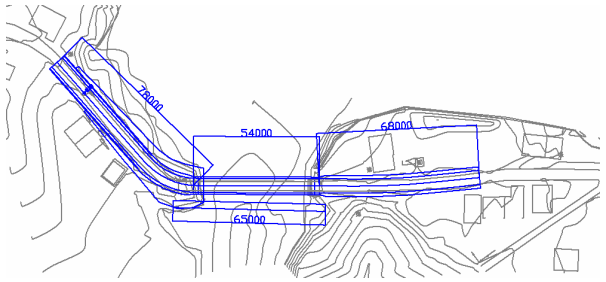
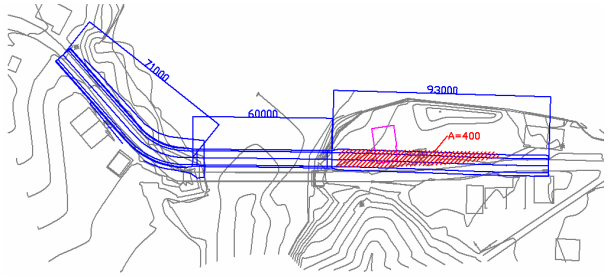
	Plan	No. of Resettle-ment	Land Acquisition Area	Relocation of Utility	Detour Route	Approach road alignment	Removal of existing bridge	Cost	Comparison
Scheme 1		Concrete house:3 (one is foundation only) Wooden house:2	225 ㎡	E. pole×1	Existing Bridge	Inter-section	After new bridge comple-tion	1.08 Bridge:92m Road:238m (including improve-ment of steep approach road)	New bridge at downstream side of existing bridge (very close to existing bridge) -Cost is higher than Scheme 2 and resettlement and land acquisition is more than Scheme 2.
Scheme 2		Concrete houses:2 (one is foundation only)	80 ㎡	E. pole×1	Existing Bridge	R=8m	After new bridge comple-tion	1.0 Bridge:94m Road:150m (including improvement of steep approach road)	New bridge at downstream side of existing bridge (right side abutment location is about 30m from existing bridge) -Cost is the lowest, and resettlement and land acquisition are only a little. Selected
Scheme 3		Concrete houses:2 (one is foundation only)	110 ㎡	E. pole×1	Existing Bridge	R=15m	After new bridge comple-tion	1.1 Bridge : 117m Road:109 m	New bridge at downstream side of existing bridge (Right abutment location is about 15m from existing bridge) -Alignment is good however cost is high since the piers are high (20m).

Table 2.2-7 (6/6) Comparison of Sa'ua Bridge Location Scheme

	Plan	No. of Resettle-ment	Land Acquisition Area	Relocation of Utility	Detour Route	Approach road alignment	Removal of existing br.	Cost	Comparison
Scheme 1		None	None	E. Pole×2	Existing Bridge	R=30m	After new bridge comple-tion	1.0 Bridge: 54m Road : 189m (cost of demolition of existing bridge is not included)	<u>New bridge at upstream side of existing bridge</u> - Salt from sea water is minimal and the cost is minimal. Selected
Scheme 2		None	None	None	Temporary Bridge	R=30m	Before constructi on of new bridge	1.1 Bridge:54m Road:146m Removal of existing br.:61m Temporary br. : 65m	<u>New bridge at existing bridge location</u> ・Salt from sea water is more than scheme 1, and cost is high.
Scheme 3		Wooden house:1	400 ㎡ (Residential area)	None	Existing Bridge	R=30m	After new bridge comple-tion	1.1 Bridge:60m Road:164m (cost of demolition of existing bridge is not included)	<u>New bridge at downstream side of existing bridge</u> ・Salt from sea water is the severest and resettlement and land acquisition are necessary.

2.2.2.3 Bridge Planning

(1) Bridge Planning

Bridge approach road alignment, revetment locations and elevation, bridge length, bridge elevation, foundation type, temporary works and miscellaneous works are planned on the basis of the site conditions as shown on Table 2.2-8.

Table 2.2-8 (1/6) Bridge Planning of Nou Bridge

Site Condition	The site is surrounded by commercial and residential area. Traffic volume at this bridge is very high.
Existing Bridge Condition and New Bridge Plan	Existing bridge is 47 m long with 3-span concrete girders. Carriageway width is 6m. The new bridge carriageway is 7 m wide and sidewalk is 1 m wide at each of both the sides. The new bridge and the existing bridge are at the same location.
Road Condition and Road Plan	The existing road is paved with asphalt. The carriageway is 6 m wide and shoulder is 1.5 m wide. The bridge approach section is embanked with retaining walls at the both sides. The bridge approach road is planned with 4% vertical alignment, the same to the existing. Radius 500 m vertical curve is planned for the bridge section. The approach road elevation is planned to be the same as the existing.
River Condition and Revetment Plan	The bridge is about 250m away from the estuary and the river is tidal. The river is about 2 m deep at deepest point. Small fishing boats pass the river to transport fishes and anchor in the river. PC sheet pile revetment is planned in front of the abutments. PC sheet piles are driven avoiding existing concrete structures and to be aligned with existing concrete revetment at up and down stream side of the bridge.
Bridge Length	Abutments are planned just behind the revetment. Consequently, the bridge length is adjusted to 41.5 m.
Bridge Elevation Plan	The new bridge soffit elevation is planned to be the same as existing because fishing boats are passing under the bridge. The freeboard clearance is high enough against floods.
Subsoil Condition And Foundation Plan	About 15 m thick soft silty clay deposits at the surface. Beneath the soft silty clay is medium stiff silty fine sand. The bearing stratum exists at 28 to 29 m deep. The pile length is planned 30 m. 1.5 m diameter bored pile is planned. Use of reverse circulation boring machine is planned since its vibration and noise are relatively low.
Temporary Work Plan and Miscellaneous Work Plan	A 6 m wide temporary bridge is planned at the downstream side of the main bridge. The temporary bridge is used for pedestrians and light vehicles. The temporary bridge is sometimes used to operate the equipment of the bridge construction work. Relocation of water pipes and telephone cables presently attached to the existing bridge is necessary. The new bridge is designed with attachment of the pipes installation under the bridge.

Table 2.2-8 (2/6) Bridge Planning of Nou A Bridge

Site Condition	Left side is shopping malls and markets. Right side is residential area.
Existing Bridge Condition and New Bridge Plan	Existing bridge is 51 m long single span steel truss with a 4.5m-wide carriageway. The new bridge carriageway is 6 m wide. The new bridge and the existing bridge are at the same location.
Road Condition and Road Plan	The bridge approach road at the left side is about 13m wide. Right side road is 6 m wide including road shoulders. Both the approach roads are on the embankment with retaining walls. Vertical alignment with 6 % is planned for the approach roads to follow the existing slope of the left side approach road. The existing right side approach road with 8 % slope will be improved to be 6 % to follow the geometric standard by providing retaining walls higher than the existing ones. New bridge is planned to be vertically curbed with 500 m radius.
River Condition and Revetment Plan	The bridge is about 100m away from the estuary and the river is tidal. The wave is gentle since the sea is surrounded by Nias and Sumatra Island. The river is about 2m deep at the deepest point. Small fishing boats pass the river to transport fishes and anchor in the river. PC sheet pile revetment is planned in front of the abutments. PC piles are driven to be aligned with existing concrete revetment at up and down stream side of the bridge.
Bridge Length	Abutments are planned just behind the revetment. Consequently, the bridge length is adjusted to 49.5 m.
Bridge Elevation Plan	The new bridge soffit elevation is planned to be the same as existing because fishing boats pass under the bridge. The freeboard clearance is quite high to avoid floods.
Subsoil Condition And Foundation Plan	About 20 m thick soft silty clay deposits at the surface. Beneath the soft silty clay is silt. The bearing stratum exists at 38 to 43 m deep. The pile length 40 to 45 m is planned. 1.5 m diameter bored pile is planned. Use of reverse circulation boring machine is planned since its vibration and noise are relatively low.
Temporary Work Plan and Miscellaneous Work Plan	A 6 m wide temporary bridge is planned at the downstream side of the main bridge. The temporary bridge is used for pedestrians and light vehicles. The temporary bridge is sometimes used to operate the equipment of the bridge construction work.

Table 2.2-8 (3/6) Bridge Planning of Gido Si'ite Bridge

Site Condition	The site is about 20km away from Gunug Sitoli City. The surroundings are farm and forest. The topography is quite hilly.
Existing Bridge Condition and New Bridge Plan	The existing bridge is 37m long combination of 2-span concrete bridges. The carriageway width is 6 m wide. The new bridge carriageway width is planned 6 m. New bridge is planned upstream side of the existing bridge because the existing bridge alignment does not meet the geometric requirements. There is a power line at the upstream side of the existing bridge. In the bridge planning, priority is given to a new bridge location without requirement to relocate the electric wire/poles. However, it was found out that relocation of a power pole or raising the power line by adding a power pole is unavoidable.
Road Condition and Road Plan	The bridge approach road is paved with 6 m wide asphalt pavement. The carriageway is 6 m wide and the road shoulder is 1.0 m wide. New bridge is planned to cross the river at the right angle. The minimum horizontal curve is 110 m. Vertical alignment with 8 % is planned for the bridge approach roads since the bridge elevation is about 1.7 m higher than the existing bridge. The vertical curb radius for the bridge is 450 m.
River Condition and Revetment Plan	The river is meandering around the site. Floods overflow the river and spread over around the site. Road section within several hundred meters from the bridges is inundated when floods occur. Since the flooded areas are extensive, no counter-measure for the flood is planned under this project. Gabion mattress revetment has been installed at the riverbanks at the upstream and downstream of the site. Gabion mattress is planned to be installed in front of the new abutments to replace the old ones and to make smooth revetment lines.
Bridge Length	New bridge length is planned to be 40 m. (Existing bridge is 37 m.) This bridge opening is adequate since the river catchment area and discharge is not large even when floods overflow.
Bridge Elevation Plan	Floods overflow on the wide area, and the stream velocity is very slow, therefore, 1 m freeboard is adequate for the bridge.
Subsoil Condition And Foundation Plan	About 38 m thick soft clay deposits on hard sand. 40 m long bored pile is planned.
Temporary Work Plan and Miscellaneous Work Plan	No temporary bridge is necessary for the work. Existing bridge will be demolished after the new bridge opening.

Table 2.2-8 (4/6) Bridge Planning of Idano Gawo Bridge

Site Condition	Topography is hilly. There are several houses along the left side approach road. An asphalt plant is located at right side riverbank. Traffic volume is low.
Existing Bridge Condition and New Bridge Plan	Existing bridge is composed of a box culvert (29m), truss bridge (60m), and temporary bailey bridge (91m). The bailey bridge has been installed over the damaged box culvert which had been scoured by floods and overturned by the earthquake. New bridge is planned to replace the truss bridge and the bailey bridge. The existing left side box culvert and the abutment of the truss bridge are planned to continue to be used. The new bridge carriageway is 6 m and sidewalk is 0.5 m.
Road Condition and Road Plan	The existing approach road is paved with 6 m wide asphalt pavement with 1.5 m shoulders. The approach road is embanked with stone masonry retaining walls at the both sides. Vertical 1 % slope is planned to the bridge approach road. Vertically curbed alignment is planned for the new bridge section with radius of 8000 m. The new bridge elevation is planned to be the same as the existing road.
River Condition and Revetment Plan	The site is the midstream of a relatively big river. The river meanders and the river alignment is being moved by floods. Scouring on right side riverbank is progressing at about 100 m upstream from the bridge, while the left side riverbank is being scoured around the bridge. To protect the new bridge from scouring, layers of gabion mattress are planned to be installed along the left riverbank and upstream side of the box culvert. Additionally, gabion mattress is planned to be installed around the box culvert to prevent erosion around the box culvert. Gabion revetment has been installed at the right side riverbank. A stone masonry wall is planned to be installed in front of the planned right side abutment.
Bridge Length	Existing truss bridge abutment is planned to be re-used and a new abutment is planned to be installed at the same location of existing abutment. Consequently, bridge length is adjusted to 151.0 m.
Bridge Elevation Plan	The bridge elevation is determined to be the same as the existing bridge. In this case, the freeboard between the design flood level and the bridge soffit is more than required 1.5 m.
Subsoil Condition And Foundation Plan	Around 5 m thick boulder layer cover the riverbed. Soft clay layer exists beneath the boulder layer and over the stiff clay of which surface exists 10 to 20 m deep from the ground surface. The bored pile is planned as same as other bridge. Oval shape pier is planned since the pile-bent type pier may not bear the loads.
Temporary Work Plan and Miscellaneous Work Plan	A detour bridge for traffic and work are planned to be installed at the upstream side of the bridge. The existing box culvert is sound and reinforcement is not necessary since no crack is seen on it. However, some reinforcing bars at the ceiling of the first cell are exposed due to poor quality of work. The exposed reinforcing bars are planned to be epoxy coated after chipping off the concrete around the bars and removal of corrosion. The pavement, sidewalk and railing on the left side box culvert are planned to be replaced with new ones.

Table 2.2-8 (5/6) Bridge Planning of Mezaya Bridge

Site Condition	The site is located in a small village surrounded with steeply slanting mountains. The bridge crosses over a deep valley close to the sea. Houses are located at the bridge approaches. Traffic volume is low.
Existing Bridge Condition and New Bridge Plan	Existing bridge is a 3-span truss with a total length of 92 m. A new bridge is planned at downstream side of the existing bridge.
Road Condition and Road Plan	The existing bridge approach is 4.5 m road with bituminously treated surface. The road is planned to be widened with 6 m wide asphalt concrete pavement. The existing right side approach road is 13 % at the most steeply slanting section. It is planned to be improved to 10 % by providing 3 % slope to the new bridge. The existing bridge is connected with the approach road with an intersection. The intersection is planned to be a curb with a radius of 8 m.
River Condition and Revetment Plan	Floods run down fast because the upstream is steep valley topography despite the site is near to estuary (about 200m to the sea). The water level is tidal. The riverbed consists of boulder containing gravels. River alignment is stable since the riverbank is weathered rime stones. A stone masonry wall is planned in front of planned abutment. Installation of concrete block scouring protections is planned at around the wall to protect wall from scouring. Installation of riprap slope protection is planned for the left side abutment slope to protect the slope from rainwater erosion.
Bridge Length	Abutments are planned where the vertical alignment of the road crosses existing slopes. Consequently bridge length is adjusted to 94m.
Bridge Elevation Plan	Bridge elevation is given by the vertical road alignment plan. The bridge elevation is far above the flood level.
Subsoil Condition And Foundation Plan	The ground is weathered rime stone. As the depth increased, the soil becomes stiffer. The N-value becomes 30 to 50 at the depth of around 15 m from the ground surface. Diameter 1.5 m bored pile is planned as same as other bridge. Grab hammer type drilling machine is planned since rime stone boulders exist in the ground.
Temporary Work Plan and Miscellaneous Work Plan	The right side approach road is planned to be a gentle slope by rising the grade, installing 2.6 m high L-shape retaining wall for around 70 m long steel section.

Table 2.2-8 (6/6) Bridge Planning of Sa'ua Bridge

Site Condition	The site is estuary crossing with the coastal road. Houses are located along the bridge approach roads. Traffic is not many. Seashore is about 50 m away from the bridge. Splashed sea water reaches the bridge when the waves are rough.
Existing Bridge Condition and New Bridge Plan	The existing bridge is a temporary 61 m long dilapidated bailey bridge. New bridge is planned at the upstream side of the existing bridge.
Road Condition and Road Plan	The existing bridge approach roads are 6 m wide asphalt paved road. The new bridge is planned at 2 m away from the existing bridge. The left side bridge approach road is connected with 30 m radius curb. The curved section is widened by 1 m. The left side curb is radius 110 m. The new bridge elevation is planned about 2 m higher than the existing bridge. The approach road is planned with 8 % slope. The bridge section is planned with vertical curb radius 450 m.
River Condition and Revetment Plan	The river flows very slowly since the site is very close to sea. The water is tidal. Installation of a stone masonry wall in front of abutments is planned. The part of the wall under the low tide level is planned to be made of base concrete. Installation of concrete block scouring protection at the wall footing is planned. Also the concrete block scouring protection will be installed along the left side approach road wall where waves directly hit the wall when storms come. Meanwhile, seawall has been installed at the right side approach.
Bridge Length	The abutment protection location is planned so as to align with the natural riverbanks at the upstream side. Consequently, the bridge length is adjusted to 53.5 m.
Bridge Elevation Plan	The flood level is not high because the site is estuary. However, the highest tide reached the existing bridge deck level according to the hearing survey. Therefore, The new bridge soffit elevation is planned at 50 cm above the existing bridge deck level.
Subsoil Condition And Foundation Plan	Silty clay layer and fine sand layer deposit alternatively. As the depth increase, the soil becomes stiffer. The N-values become 30 to 50 at the depth of around 20 m from the ground surface. Diameter 1.5 m bored pile is planned the same as the other bridges. Grab hammer type drilling machine is planned since rime stone boulders exist in the ground.
Temporary Work Plan and Miscellaneous Work Plan	In order to construct the right side new abutment, about 10 m long part of the bailey bridge is necessary to be removed. Before the removal of the part of the existing bridge, temporary embankment to shift the approach road is necessary. Existing bailey bridge is dilapidated and dangerous for heavy vehicles to pass, therefore, reinforcement of the bridge is necessary.

(2) Span Arrangement

The most efficient span length for integral steel girder is 20 to 40m. Comparative span arrangement of the project bridges are shown on Table 2.2-9.

Table 2.2-9 Comparative Span Arrangement of Project Bridges

Bridge Name	Length(m)	Scheme 1	Scheme 2
Nou	41.5	1-span	3-spans
Nou A	49.5	2-spans	—
Gido Si'ite	40.0	1-span	2-spans
Idano Gawo	151.0	4-spans	5-spans
Mezaya	94.0	3-spans	4-spans
Sa'ua	53.5	2-spans	—

Note: 2-span is not applicable for Nou Bridge since a pier cannot be installed at the center of the river.

As the result of the cost comparison, the least span schemes are selected for all bridges.

2.2.3 BASIC DESIGN DRAWINGS

The major components of the Project are shown on Table 2.2-10. The Basic Design Drawings are shown on the following pages.

Table 2.2-10 Major Components of the Project

Bridge Name		Nou	Nou A	Gido Si'ite	Idano Gawo	Mezaya	Sa'ua
Bridge Length		41.5 m	49.5 m	40.0 m	151.0 m	94.0 m	53.5 m
Span		1@41.5	2@24.75	1@40.0	3.0+32.0+ 2@42.0+32.0	29.0+36.0+ 29.0	2@26.75
Bridge Width	Carriageway	7.0 m	6.0 m	6.0 m	6.0 m	6.0 m	6.0 m
	Sidewalk	1.0 m	0.5 m	0.5 m	0.5 m	0.5 m	0.5 m
	Total	9.5 m	7.5 m	7.5 m	7.5 m	7.5 m	7.5 m
Superstructure Type		Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder	Steel Plate Girder
Substructure Type		Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent	Bored Pile Bent
Bridge Deck Pavement		AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)	AC (6cm)
Approach Road Length		70.8 m	90.5 m	180.0 m	209.0 m	181.0 m	186.5 m
App. Road Width	Carriageway	7.0 m	6.0 m	6.0 m	6.0 m	6.0 m	6.0 m
	Sidewalk	1.0 m	1.0 m	1.0 m	1.0 m	1.0 m	1.0 m
Approach Road Pavement		AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)	AC (8cm)
Approach Road Retaining Wall Length		39.0 m	73.0 m	0.0	0.0	95.0 m	129.0 m
Revetment Type		PC Sheet Pile	PC Sheet Pile	Gabion Mattress	Gabion Mattress	Gabion+Wall+ Conc. Block	Wall + Conc. Block
Revetment Quantity		74.0 m	48.0 m	Gabion 53 ea.	Gabion 680 ea.	Gabion 22ea+ Wall 17.0m + Conc. Block 25 ea.	Wall 42.0 m, Conc. Block 486 ea.

Total Bridge Length	429.5 m
Total Approach Road Length	917.8 m

REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HIGHWAYS

THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA

BASIC DRAWINGS

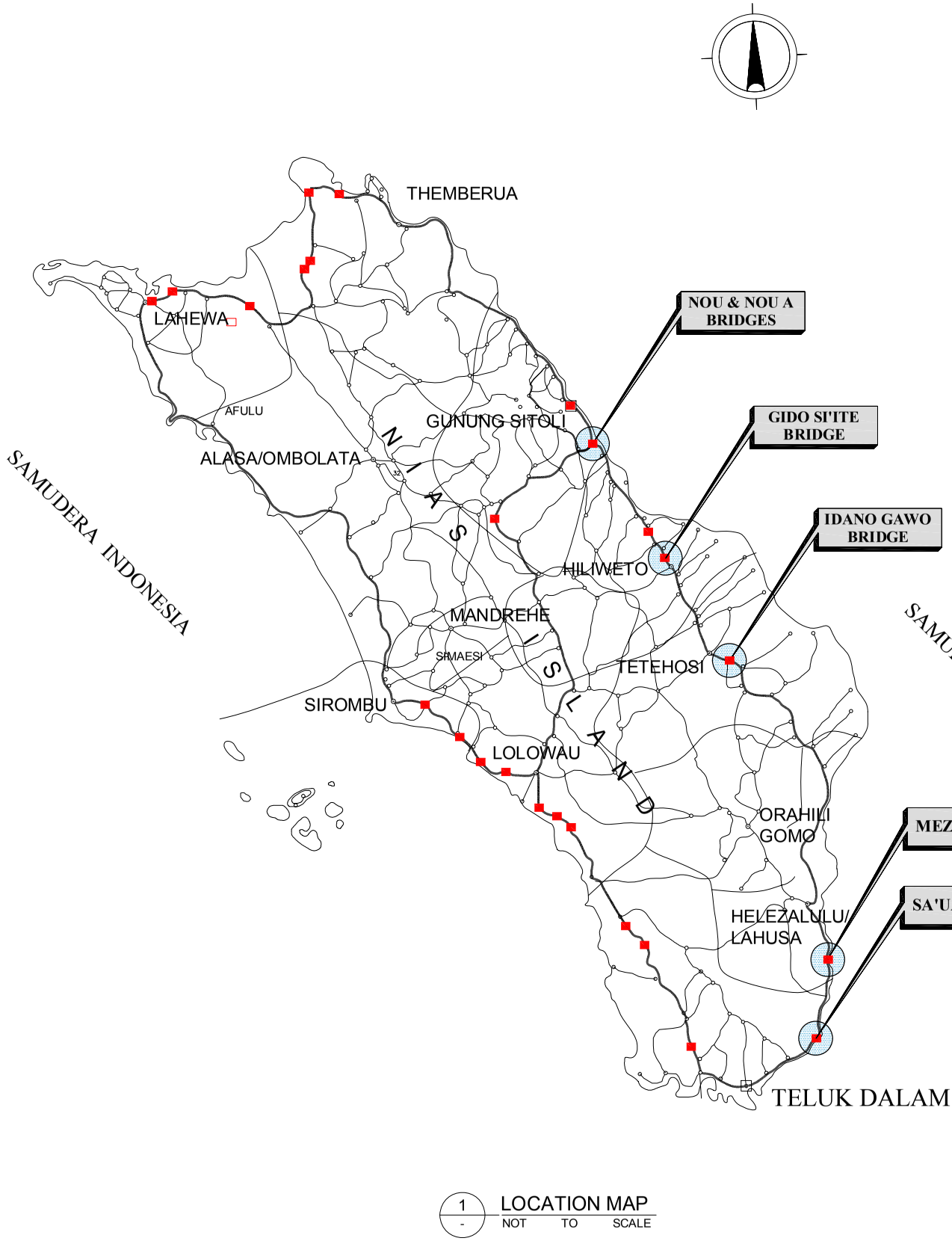
JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

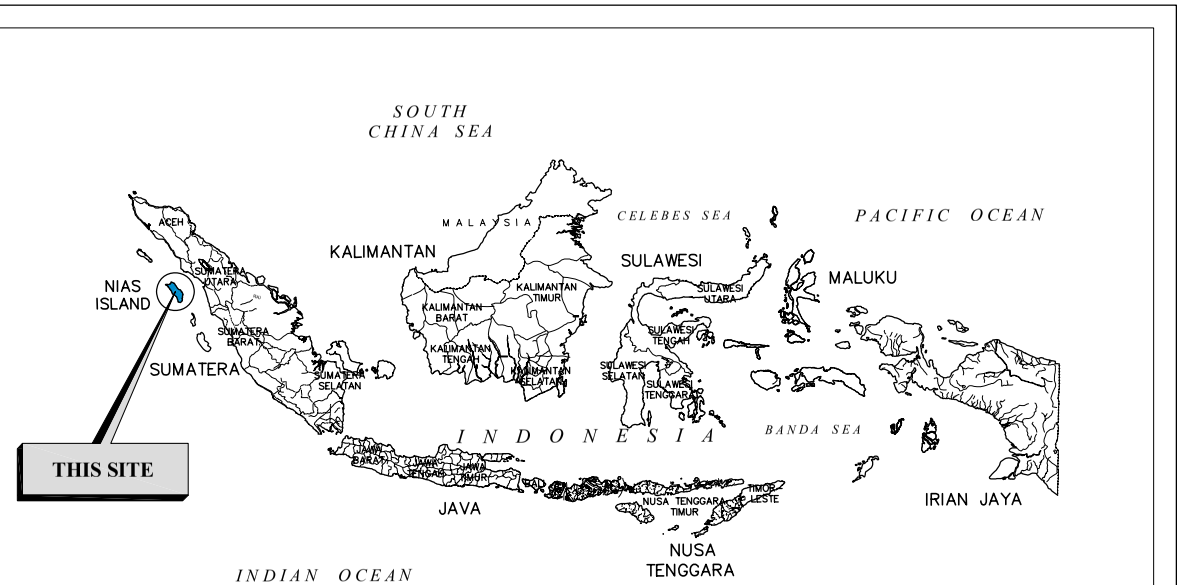
2-32

INDEX OF DRAWINGS

DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : INDEX OF DRAWINGS	SCALE : N T S	DRAWING No: 0-1	Rev.



1 - LOCATION MAP
NOT TO SCALE



2 - KEY MAP
NOT TO SCALE

DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NIAS ISLAND BRIDGES (LOCATION MAP AND KEY MAP)	SCALE : NOT TO SCALE	DRAWING No: 0-2 Rev.

GENERAL NOTES FOR BRIDGES

A. DESIGN CRITERIA

1. CODES AND SPECIFICATIONS

THE DESIGN STANDARDS FOR THE STRUCTURES ARE :

- BRIDGE DESIGN MANUAL, BRIDGE MANAGEMENT SYSTEM (BMS6), BINA MARGA, 1992.
- STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO), 17TH EDITION 2002.
- SPECIFICATIONS FOR HIGHWAY BRIDGES, JAPAN ROAD ASSOCIATION (JRA), 2002

2. UNIT WT. OF MATERIALS

	UNIT WEIGHT
A. REINFORCED CONCRETE	25.00 kN/m^3
B. PLAIN CONCRETE	24.00 kN/m^3
C. ASPHALT WEARING COARSE	22.00 kN/m^3
D. STEEL	77.00 kN/m^3
E. COMPACTED SAND, EARTH OR GRAVEL	19.00 kN/m^3
F. SATURATED EARTH OR WATER	9.81 kN/m^3
G. OTHERS	AS INDICATED

B. MATERIALS

1. CONCRETE

a). UNLESS OTHERWISE INDICATED ON PLANS, THE CONCRETE CLASS / 28–DAY COMPRESSIVE STRENGTH SHALL BE AS FOLLOWS:

STRUCTURAL MEMBER	CLASS	28–DAY COMPRESSIVE STRENGTH MPa	MAX. AGG. SIZE	SLUMP
DECK SLAB, SIDEWALK, APPROACH SLAB	A	30	25	8–12
BORED PILES	B	30	25	18–22
ABUTMENTS & PIERS	C	30*	25	8–12
FOOTING & RETAINING WALL	D	24	25	8–12
RAIL POST	E	30	15	8–12
PLAIN CONCRETE WALL CONCRETE BASE LEAN CONCRETE	F	18	25	6–8

CONCRETE COVER OF REINFORCEMENT

MINIMUM CLEAR COVER FOR REINFORCEMENT		
STRUCTURE MEMBER	NOU, NOU A, MEZAYA AND SA'UA BRIDGE	IDANO GAWO AND GIDO SIITE BRIDGE
SLAB	50 mm	50 mm
ABUTMENT AND PIER COPING	75 mm	75 mm
PIER COLUMNS	150 mm	75 mm
BORED PILES	150 mm	120 mm
RAILINGS AND SIDEWALK	40 mm	40 mm

2. STRUCTURAL STEEL, BOLTS AND WELDS

MATERIALS	REFERENCE SPECIFICATIONS
FOR MAIN MEMBER AND SPLICE	JIS G 3106–SM490Y
FOR DIAPHRAGM AND STIFFENER	JIS G 3101–SM400
OTHER MINOR MEMBERS	JIS G 3101–SS400

STEEL MATERIALS OF SA'UA BRIDGE SHALL BE COATED WITH EPOXY RESIN AND PAINT ON THE GALVANIZED SURFACE.THE EPOXY RESIN AND THE PAINTING SHALL COMPLY WITH THE TECHNICAL SPECIFICATION OF THIS CONTRACT.

3. REINFORCING STEEL

a) ALL REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO SD 40, MINIMUM YIELD POINT 390 N/MM.

BAR SIZE	BAR AREA mm^2	WT. (Kg/m)
10mm	78.5	0.617
13mm	132.7	1.042
16mm	201.1	1.578
19mm	283.5	2.226
22mm	360.1	2.984
25mm	490.9	3.853
29mm	662.9	5.185
32mm	804.2	6.313

b) UNLESS OTHERWISE INDICATED IN THE PLANS, THE MINIMUM DEVELOPMENT LENGTH.

BAR SIZE	MIN DEVELOPMENT LENGTH		MIN LAP SPLICE	
	COMP.	TENSION	COMP.	TENSION
10mm	200mm	300mm	300mm	325mm
13mm	260mm	390mm	390mm	422mm
16mm	320mm	480mm	480mm	520mm
19mm	380mm	570mm	570mm	617mm
22mm	440mm	660mm	660mm	715mm
25mm	500mm	750mm	750mm	812mm
29mm	580mm	870mm	870mm	942mm
32mm	640mm	960mm	960mm	1040mm

C. CONSTRUCTION

ALL WORKS SHALL COMPLY WITH THE TECHNICAL SPECIFICATIONS OF THIS CONTRACT.

1. DIMENSIONS

1.1 SECTION, DIMENSIONS AND DISTANCES SHALL NOT BE SCALED FOR CONSTRUCTION PURPOSES. THE INDICATED DIMENSION SHALL GOVERN UNLESS OTHERWISE SPECIFIED.

1.2 ALL DIMENSIONS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

1.3 ALL STATIONING ARE IN KILOMETER PLUS METER AND ELEVATION IN METER.

2. REINFORCED CONCRETE

a. ALL EXPOSED EDGES SHALL BE CHAMFERED 25mm EXCEPT RAILINGS WHICH SHALL BE CHAMFERED AND FILLETED 13mm.

b. FOR CONCRETE DEPOSITED AGAINST THE GROUND, LEAN CONCRETE WITH A MINIMUM THICKNESS OF 50mm SHALL LAID FIRST BEFORE INSTALLING THE REINFORCEMENT. THIS LEAN CONCRETE SHALL NOT BE CONSIDERED IN MEASURING THE STRUCTURAL DEPTH OF CONCRETE SECTION.

c. BAR BENDING, SPLICING AND PLACING

(1) THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER/CONSULTANT FOR APPROVAL OF SHOP DRAWINGS INDICATING THE BENDING, CUTTING, SPLICING AND INSTALLATION OF ALL REINFORCING BARS.

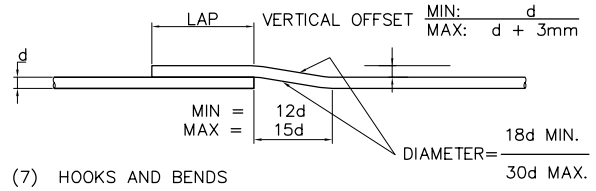
(2) BARS SHALL BE BEND COLD. BARS PARTIALLY EMBEDDED IN CONCRETE SHALL NOT BE FIELD BENT UNLESS PERMITTED BY THE ENGINEER/CONSULTANT.

(3) BAR SPLICING NOT INDICATED ON DRAWINGS SHALL BE SUBJECT TO THE APPROVAL OF THE ENGINEER.

(4) NOT MORE THAN 50% OF THE BARS AT ANY ONE SECTION SHALL BE SPLICED.

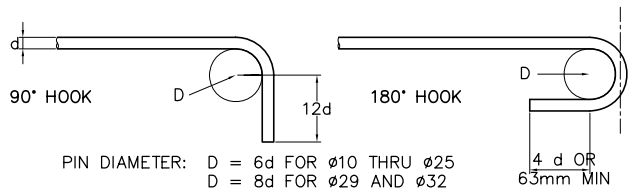
(5) UNLESS OTHERWISE SHOWN ON DRAWINGS, THE CLEAR DISTANCE BETWEEN PARALLEL BARS IN A LAYER SHALL NOT BE LESS THAN 1.5 TIMES THE NOMINAL DIAMETER OF THE BAR NOR LESS THAN 1.5 TIMES THE MAXIMUM SIZE OF COARSE AGGREGATE. THE CLEAR DISTANCE BETWEEN LAYERS SHALL NOT BE LESS THAN 25mm NOR ONE BAR DIAMETER. THE BARS IN THE UPPER LAYER SHALL BE PLACED DIRECTLY ABOVE THOSE IN THE BOTTOM LAYER.

(6) CRANKED SPLICES



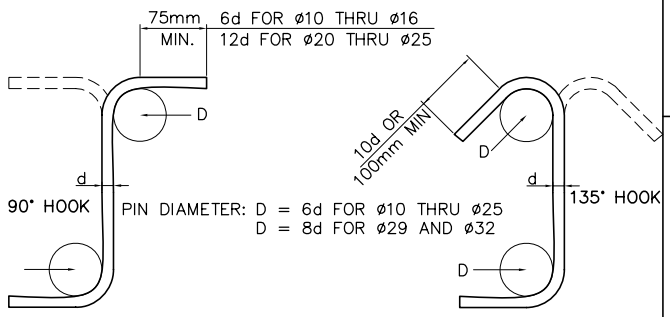
(7) HOOKS AND BENDS

DIMENSIONS OF 90–DEGREE AND 180–DEGREE HOOKS



PIN DIAMETER: D = 6d FOR ø10 THRU ø25
D = 8d FOR ø29 AND ø32

(8) DIMENSIONS FOR STIRRUPS AND TIE HOOKS



PIN DIAMETER: D = 6d FOR ø10 THRU ø25
D = 8d FOR ø29 AND ø32

d. CONSTRUCTION JOINT

(1) THE POSITION AND FORM OF ANY CONSTRUCTION JOINT SHALL BE AS SHOWN ON DRAWINGS OR AS AGREED WITH THE ENGINEER/CONSULTANT.

(2) THE INTERFACE BETWEEN THE FIRST AND SECOND POUR CONCRETES SHALL BE ROUGHENED WITH AN AMPLITUDE OF 6MM MINIMUM.

e. FALSEWORK

ALL FALSEWORK SHALL BE DESIGNED BY THE CONTRACTOR SUBJECT TO THE APPROVAL BY THE ENGINEER/CONSULTANT.

f. FORMWORK

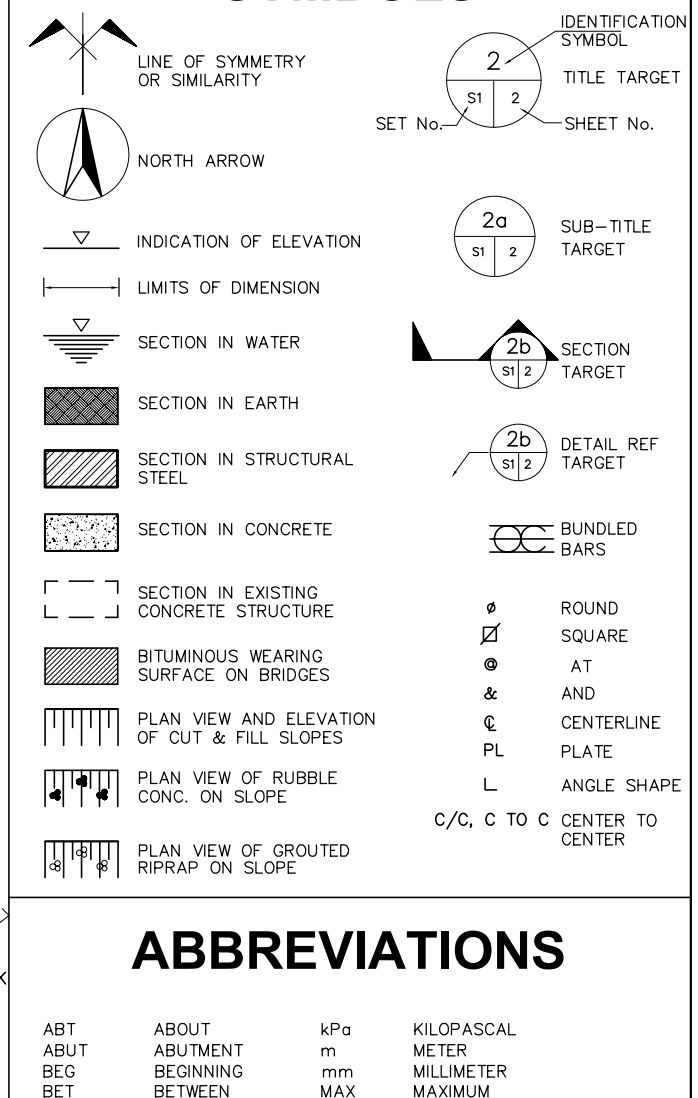
FORMWORKS SHALL BE CONSTRUCTED SUCH THAT IT WILL NOT YIELD UNDER THE LOAD AND SHALL BE SUCH AS TO AVOID THE FORMATION OF FINE. ALL CORNERS OF CONCRETE MEMBERS SHALL BE CHAMFERED TO 25mm UNLESS NOTED OTHERWISE ON DRAWINGS. STRIPPING OF FORMS AND SHORES SHALL BE AS DESIGNATED BY THE ENGINEER/CONSULTANT. THE FOLLOWING MAYBE USED AS A GUIDE.

	MIN. TIME
SHORING UNDER GIRDERS, BEAMS, FRAMES. . . .	14 DAYS
DECK SLABS	14 DAYS
WALLS.	7 DAYS
COLUMNS.	7 DAYS
SIDES OF BEAMS AND ALL OTHER VERTICAL SURFACES	2 DAYS

g. PROTECTION AND CURING OF CONCRETE

CONCRETE SURFACES SHALL BE PROTECTED FROM HARMFULS EFFECTS OF SUN, WIND AND RUNNING WATERS AND SHALL BE KEPT DAMP FOR AT LEAST 7 DAYS.

SYMBOLS



ABBREVIATIONS

ABT	ABOUT	kPa	KILOPASCAL
ABUT	ABUTMENT	m	METER
BEG	BEGINNING	mm	MILLIMETER
BET	BETWEEN	MAX	MAXIMUM
BOTT	BOTTOM	MFWL	MAX. FLOOD WATER LEVEL
BR	BRIDGE	MIN	MINIMUM
BRG	BEARING	MO	MIDDLE ORDINATE
CLR	CLEAR	MPa	MEGAPASCAL
cm	CENTIMETER	N	NEWTON
COL	COLUMN	NF	NEAR FACE
CONC	CONCRETE	No.	NUMBER
CONST	CONSTRUCTION	O.C.	ON CENTER
CTR	CENTER	PEJ	PREMOULDED EXPANSION JOINT
DET	DETAIL	PVC	POLYVINYL CHLORIDE
DIAM	DIAMETER	PVI	POINT OF VERT. INTERSECTION
DIAPH	DIAPHRAGM	QTY	QUANTITY
DWG	DRAWING	R	RADIUS
EA	EACH	RC	REINFORCED CONCRETE
EF	EACH FACE	RDWY	ROADWAY
ELEV	ELEVATION	REINF	REINFORCEMENT
ENGR	ENGINEER	SDWK	SIDEWALK
EQ	EQUAL	SL	SLOPE
EW	EACHWAY	SP	SPIRAL
EXP	EXPANSION	SPCD	SPACED
EXT	EXTERIOR	SPCS	SPACES
EXIST	EXISTING	STD	STANDARD
FF	FAR FACE	STIR	STIRRUP
FTG	FOOTING	STA	STATION
GEN	GENERAL	STRUCT	STRUCTURE
HOR	HORIZONTAL	SYMM	SYMMETRY
HW	HIGH WATER	THK	THICK
INT	INTERIOR	TYP	TYPICAL
INTERM	INTERMEDIATE	VAR	VARIABLE
JT	JOINT	VERT	VERTICAL
L	LENGTH	VOL	VOLUME
LG	LONG	W	WIDTH
kg	KILOGRAM	W/	WITH
kN	KILONEWTON	&	AND

DIRECTORATE GENERAL OF HIGHWAY
MINISTRY OF PUBLIC WORKS
THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

KATAHIRA & ENGINEERS INTERNATIONAL

THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA

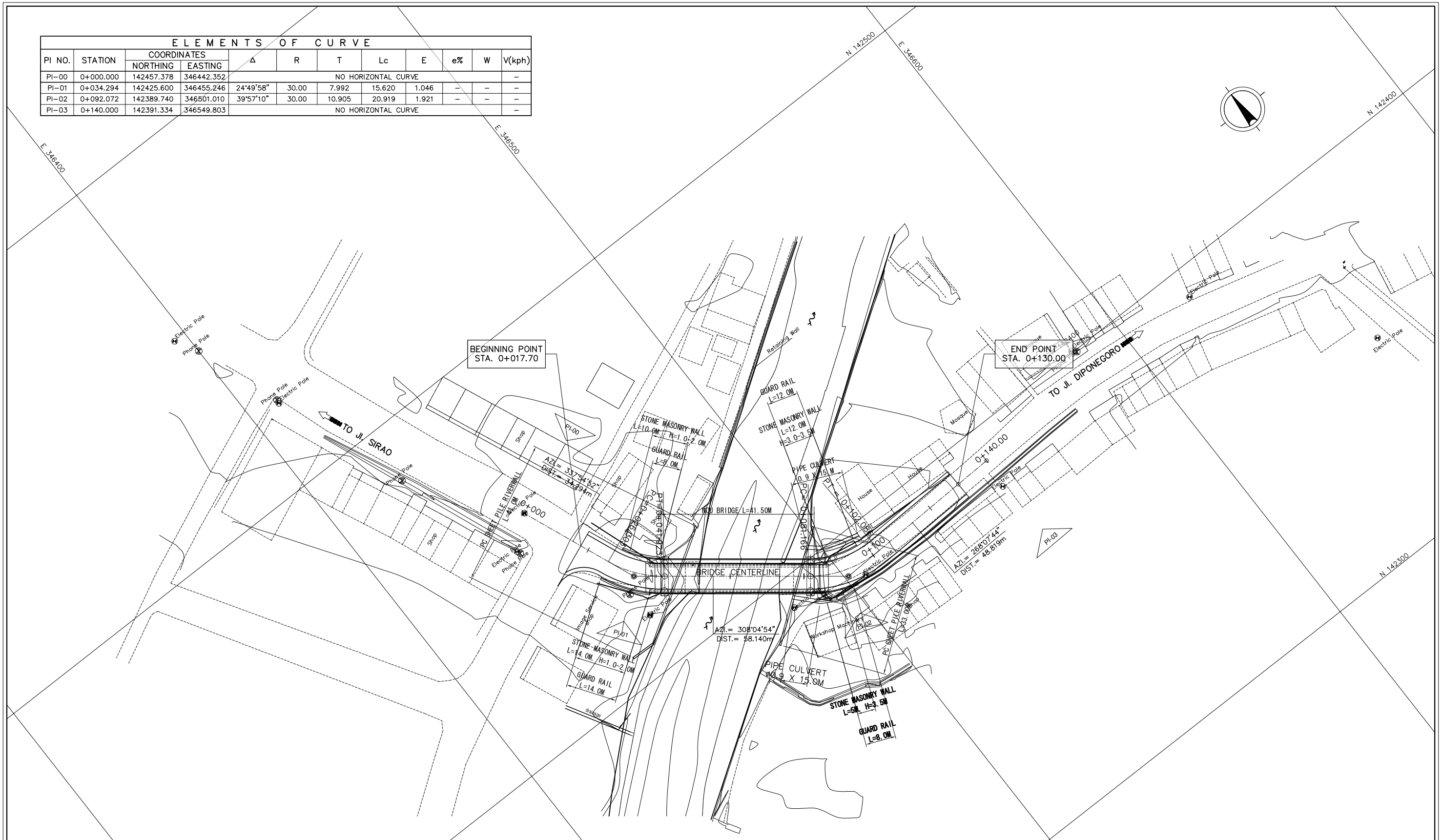
TITLE : GENERAL NOTES -

SCALE : AS SHOWN

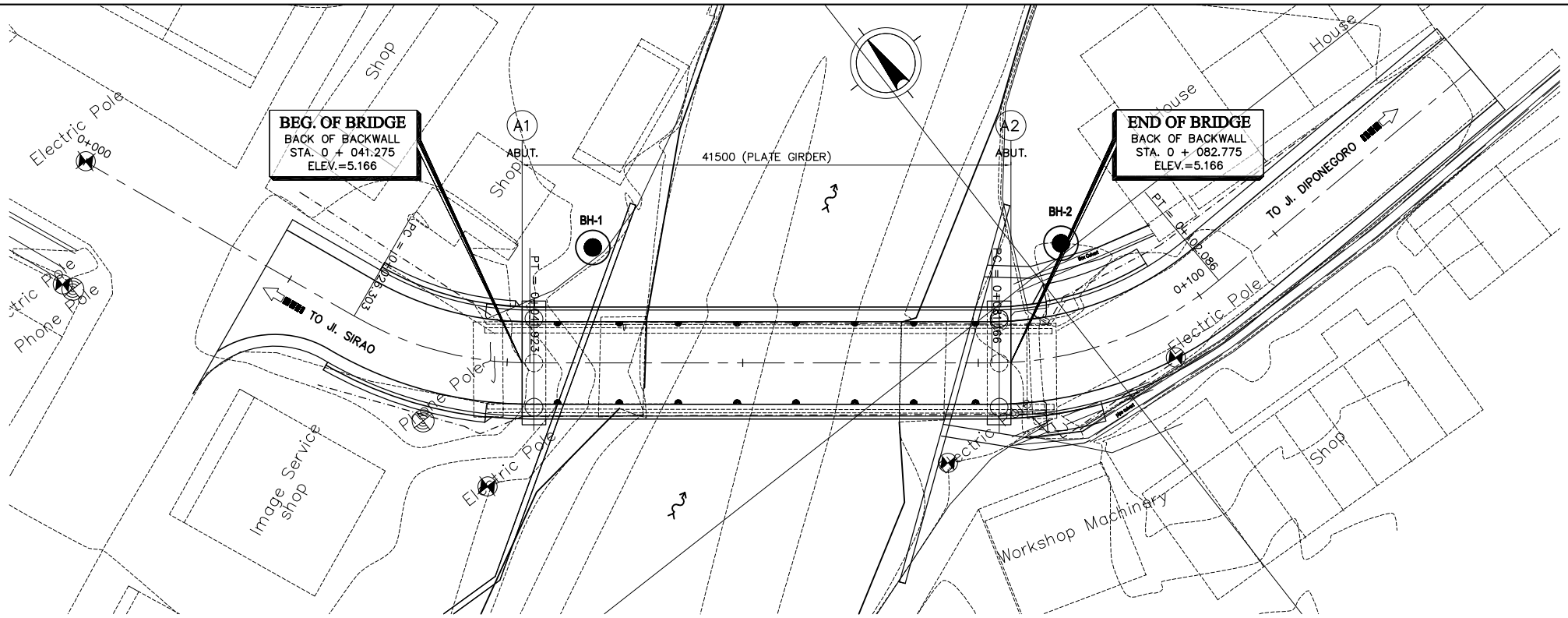
DRAWING No: 0-3

Rev.

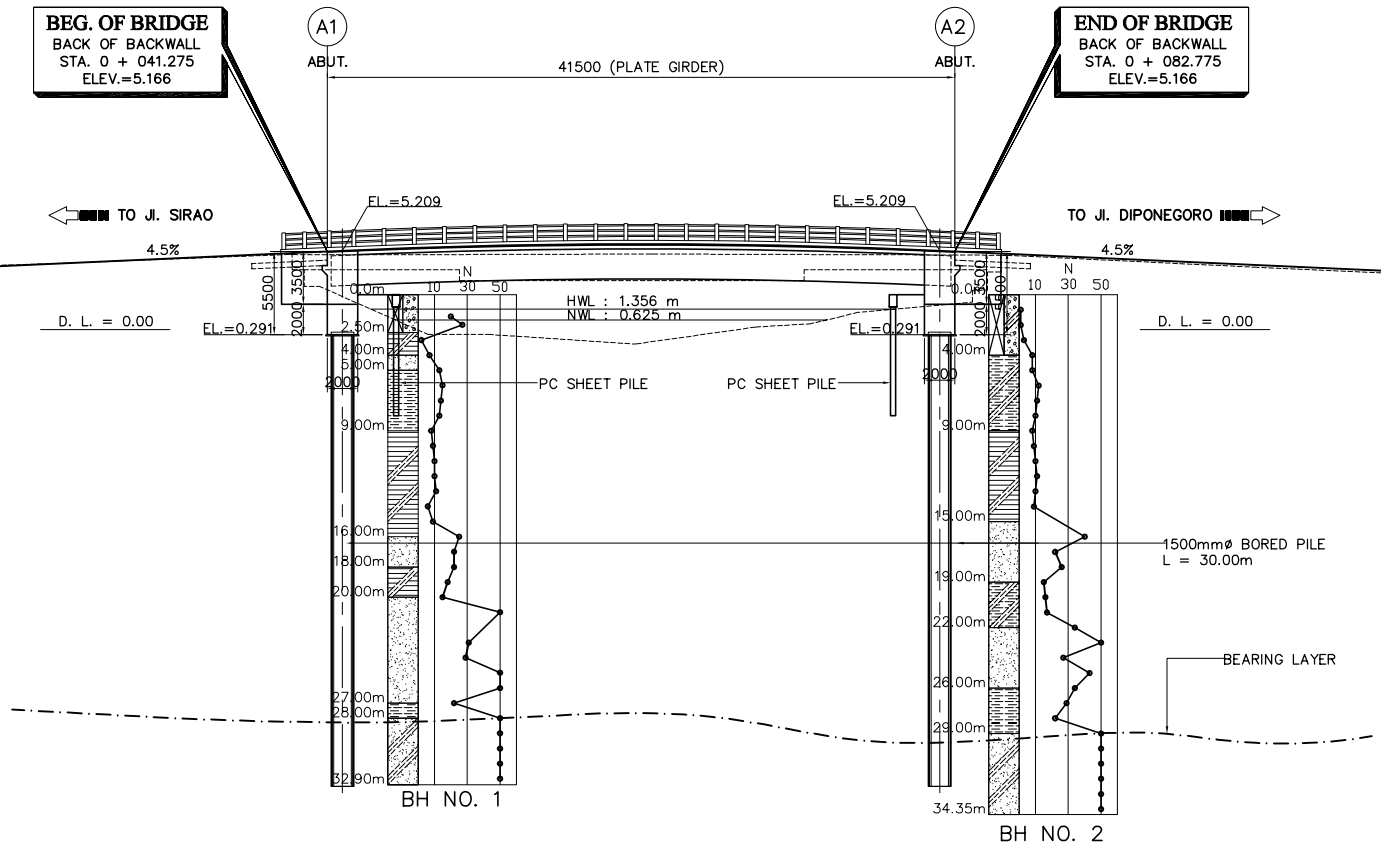
ELEMENTS OF CURVE										
PI NO.	STATION	COORDINATES		Δ	R	T	Lc	E	e%	W	V(kph)
		NORTHING	EASTING								
PI-00	0+000.000	142457.378	346442.352	NO HORIZONTAL CURVE							–
PI-01	0+034.294	142425.600	346455.246	24°49'58"	30.00	7.992	15.620	1.046	–	–	–
PI-02	0+092.072	142389.740	346501.010	39°57'10"	30.00	10.905	20.919	1.921	–	–	–
PI-03	0+140.000	142391.334	346549.803	NO HORIZONTAL CURVE							–



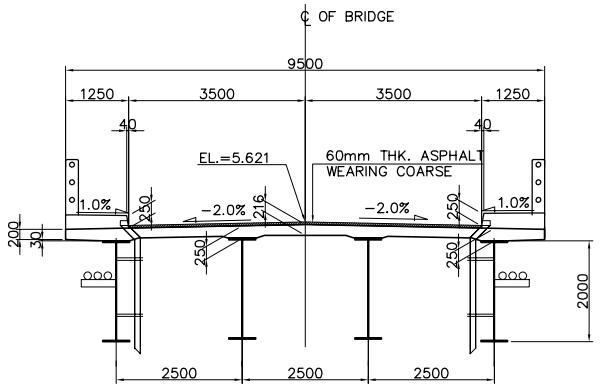
DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE (GENERAL SITE PLAN)	SCALE : 1:1000	DRAWING No: 1-1 Rev.



1 GENERAL PLAN
SCALE 1:500



2 GENERAL ELEVATION
SCALE 1:500



3 SECTION @ MIDSPAN
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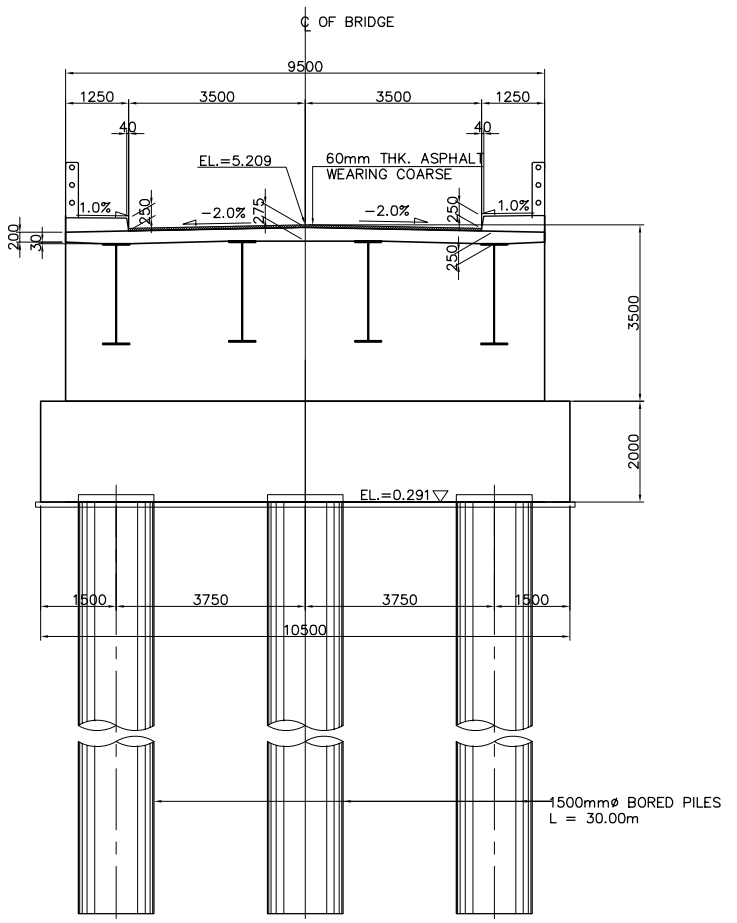
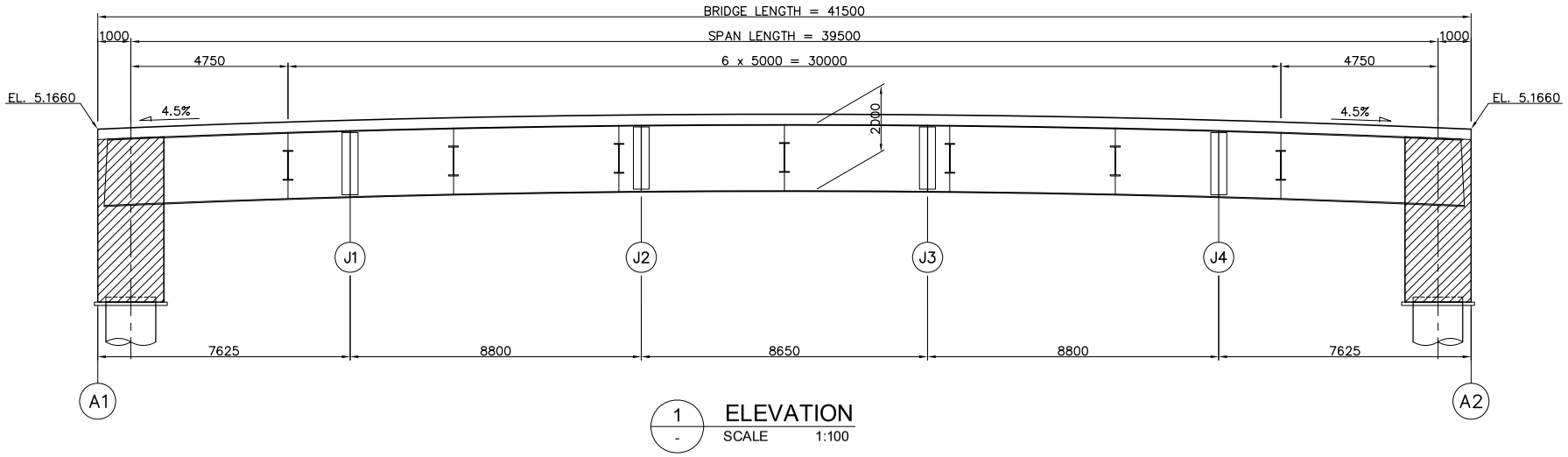
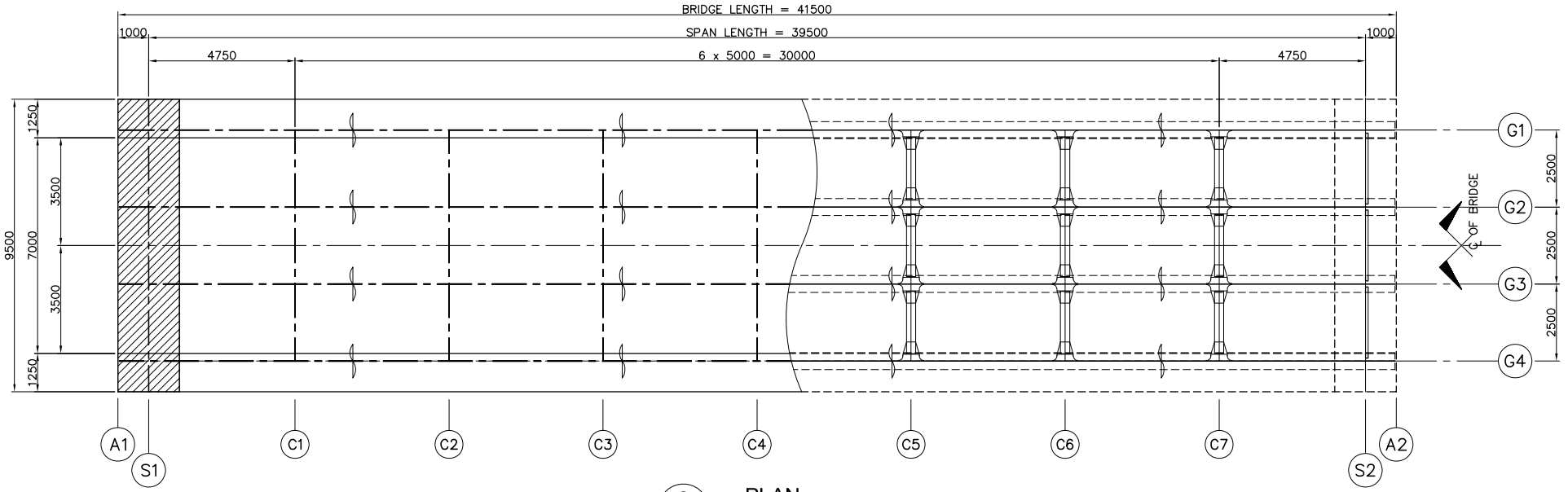


4 SECTION @ ABUTMENT
SCALE 1:150

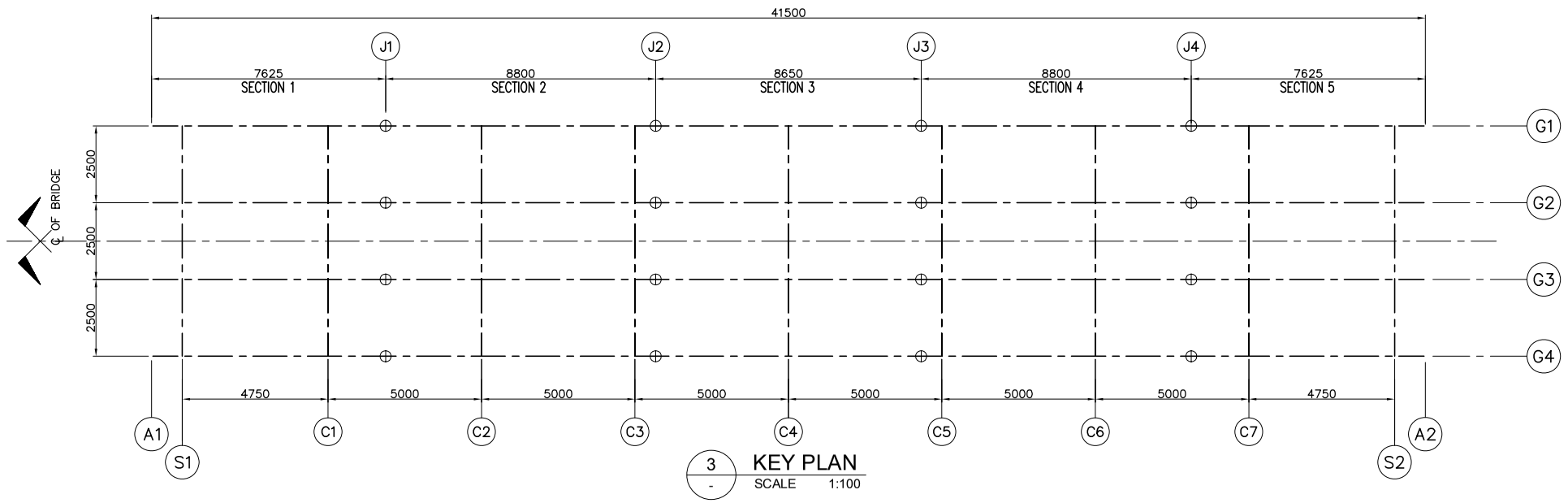
DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE GENERAL VIEW	SCALE : AS SHOWN	DRAWING No: 1-2	Rev.



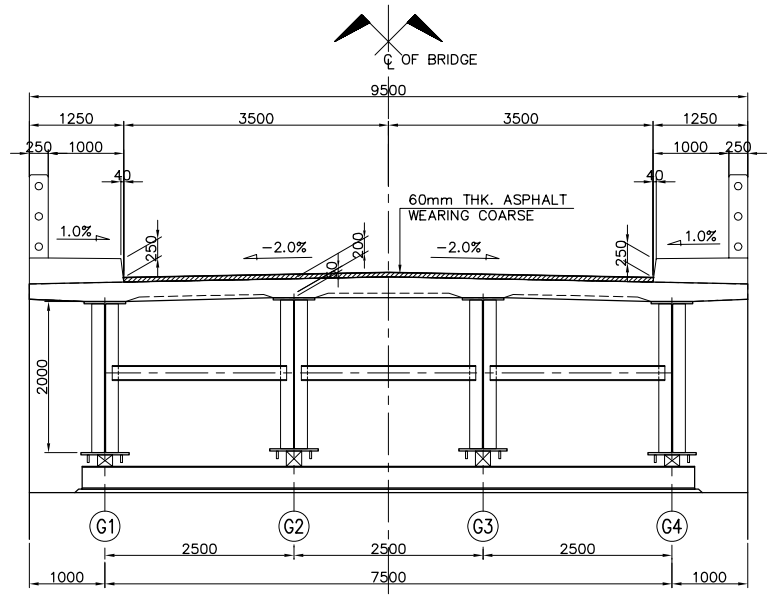
1 - ELEVATION
SCALE 1:100



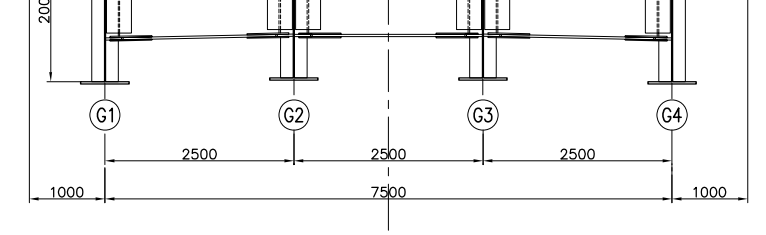
2 - PLAN
SCALE 1:100



3 - KEY PLAN
SCALE 1:100

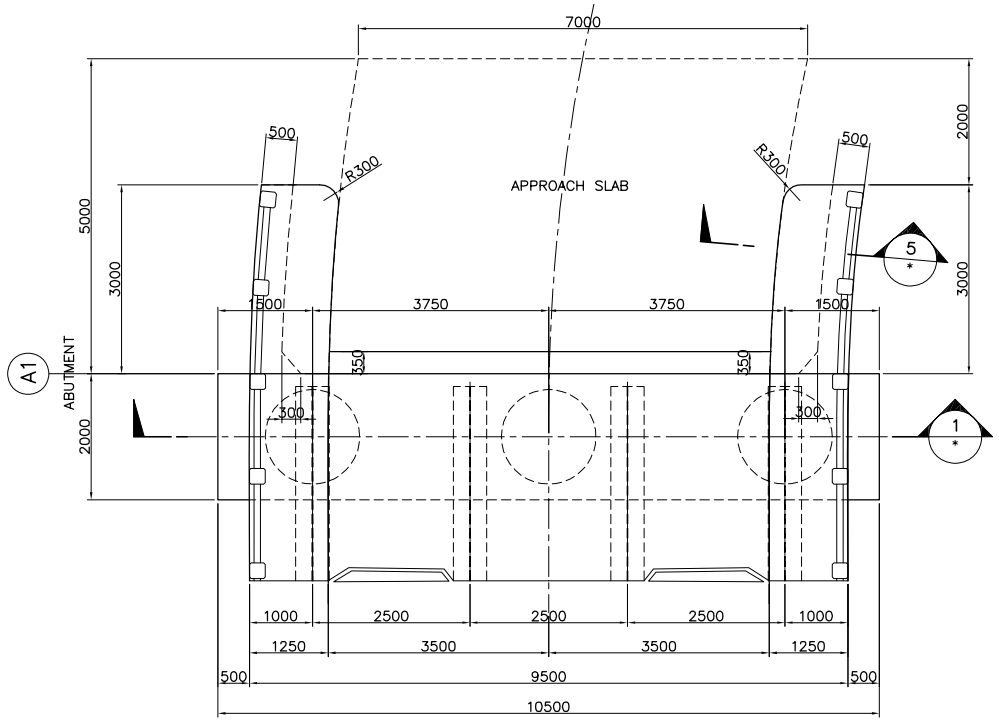


4 - SECTION @ S1 & S2
SCALE 1:50

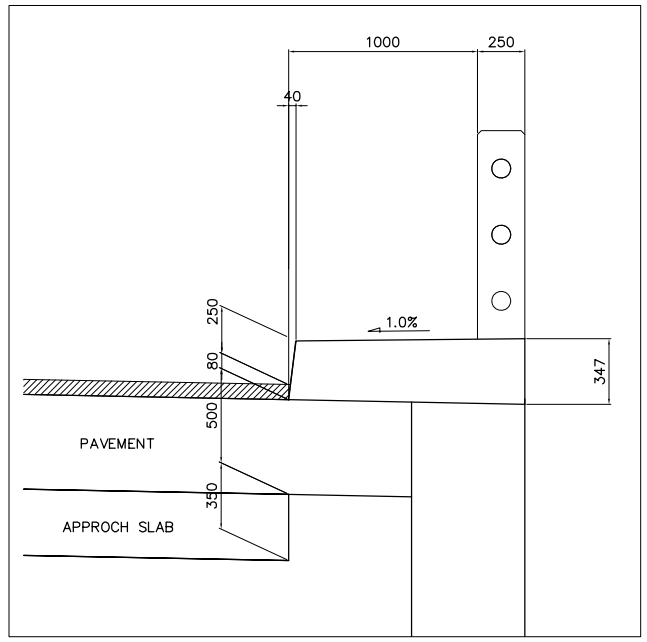


5 - SECTION @ C1~C7
SCALE 1:50

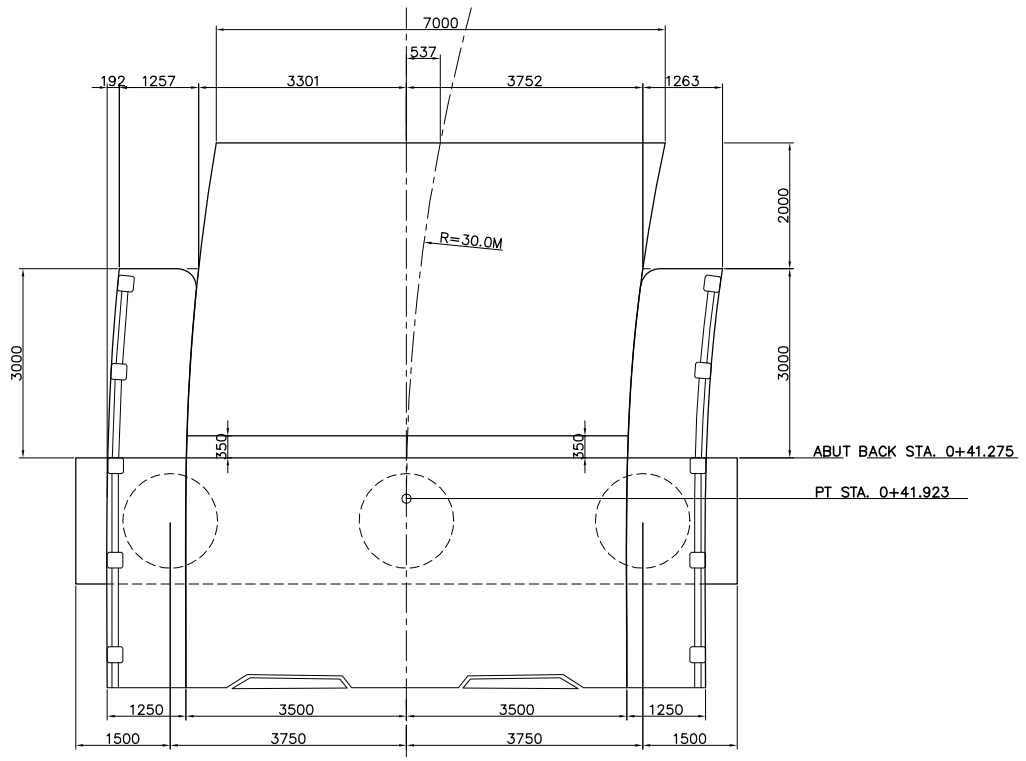
DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE GENERAL DIMENSION OF SUPERSTRUCTURE	SCALE : AS SHOWN	DRAWING No: 1-3	Rev.



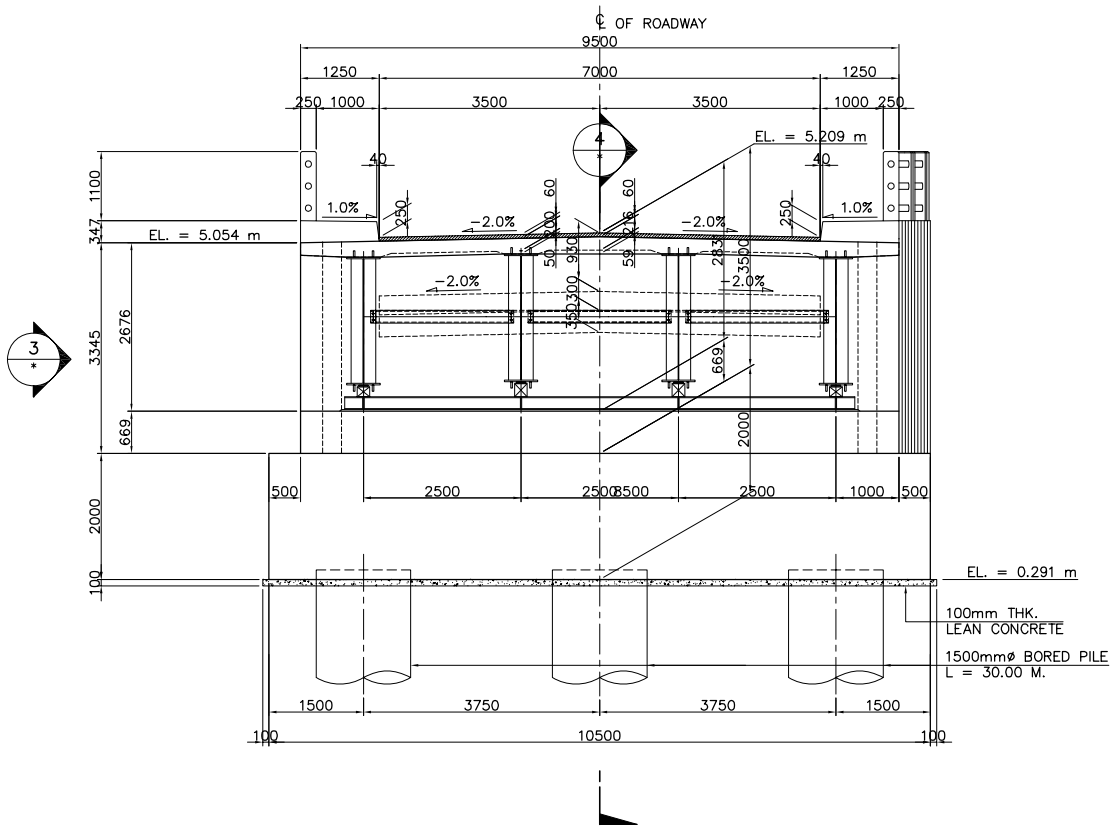
2 P L A N
SCALE 1:60



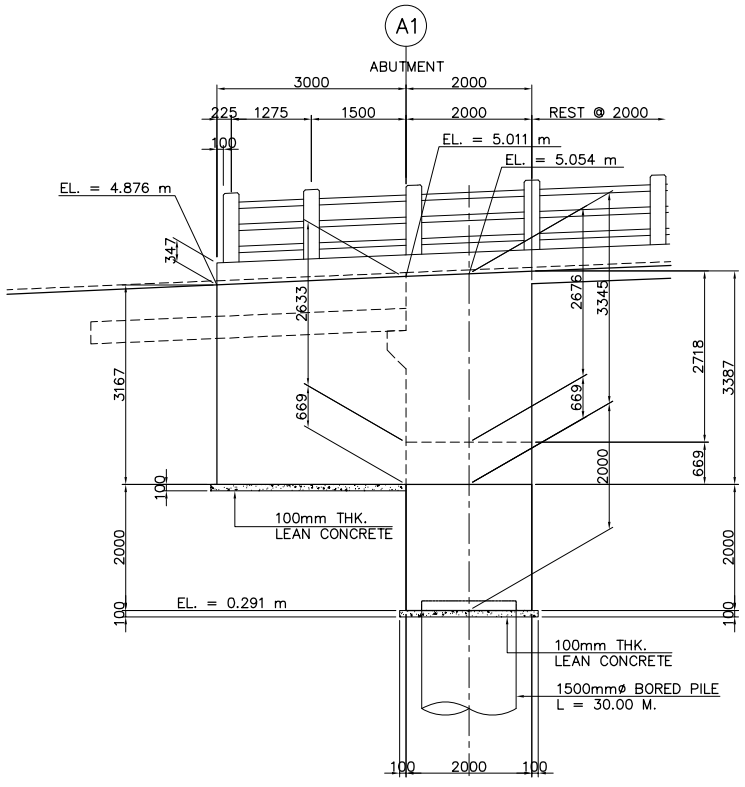
5 SECTION
SCALE 1:20



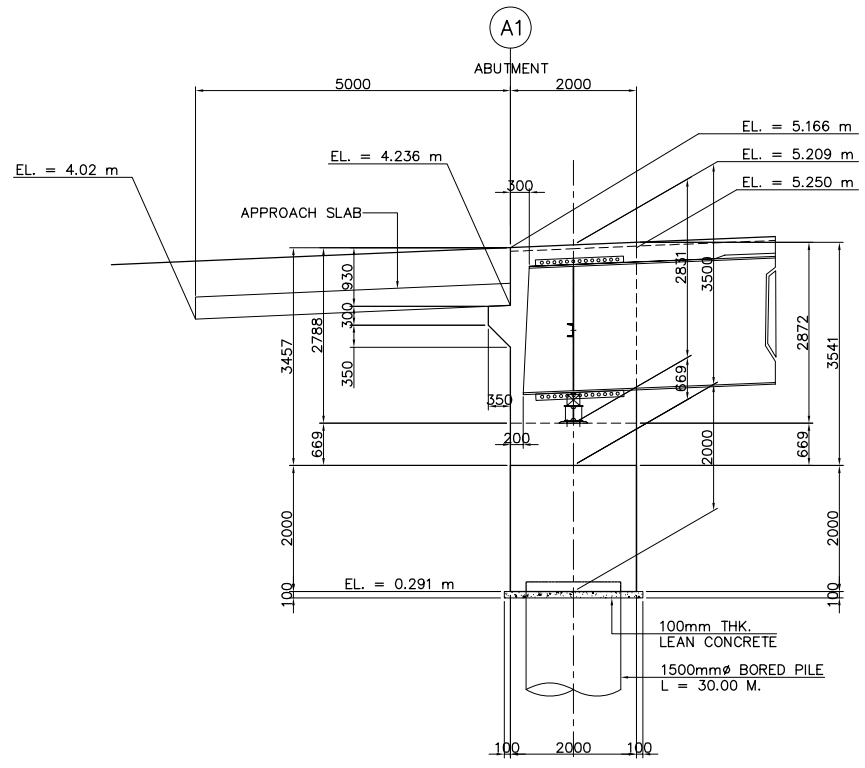
6 DIMENSION OF CURVATURE
SCALE 1:60



1 SECTION
SCALE 1:60

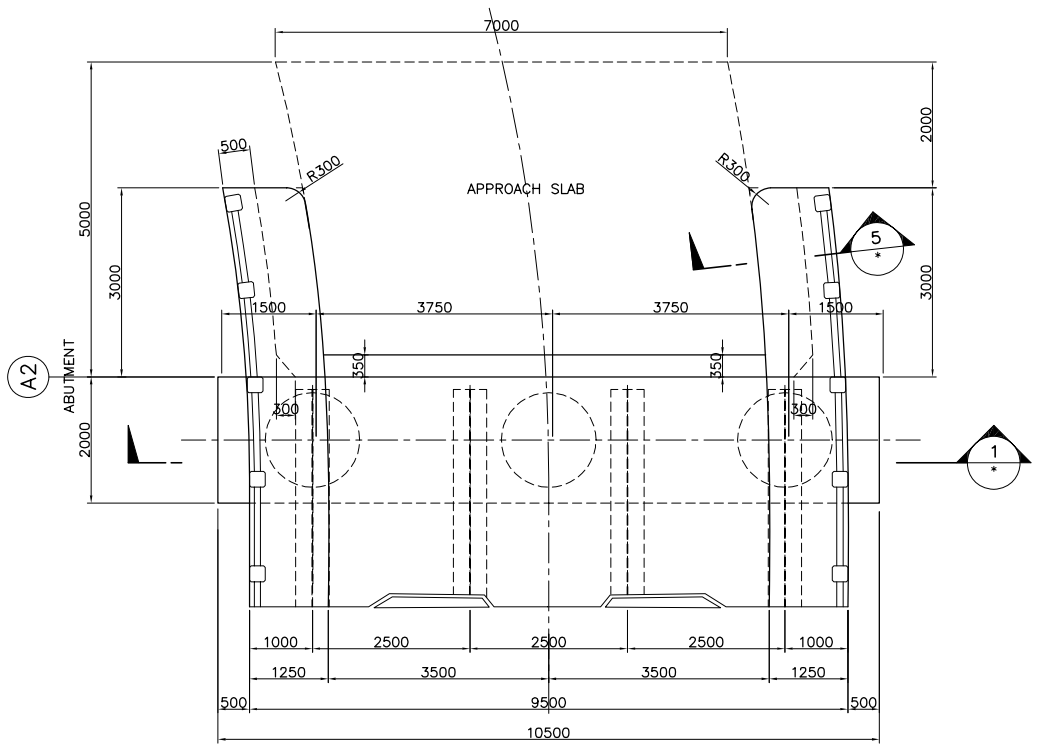


3 ELEVATION
SCALE 1:60

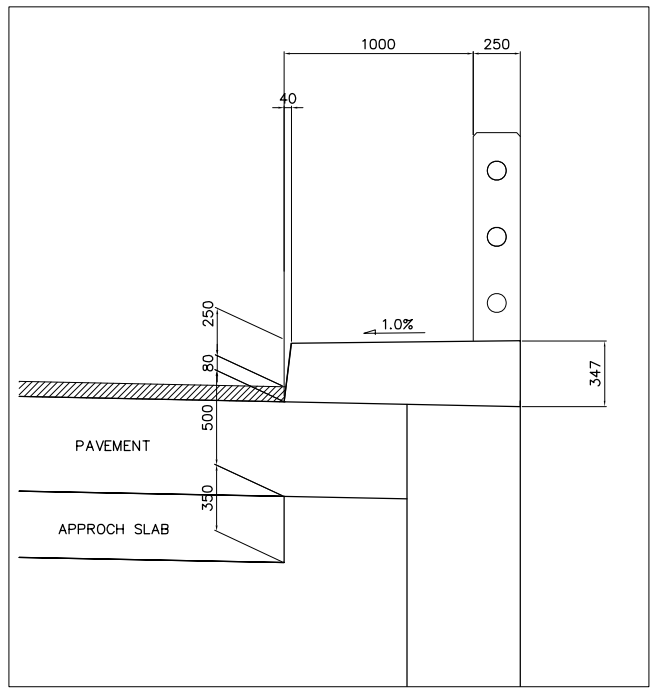


4 SECTION
SCALE 1:60

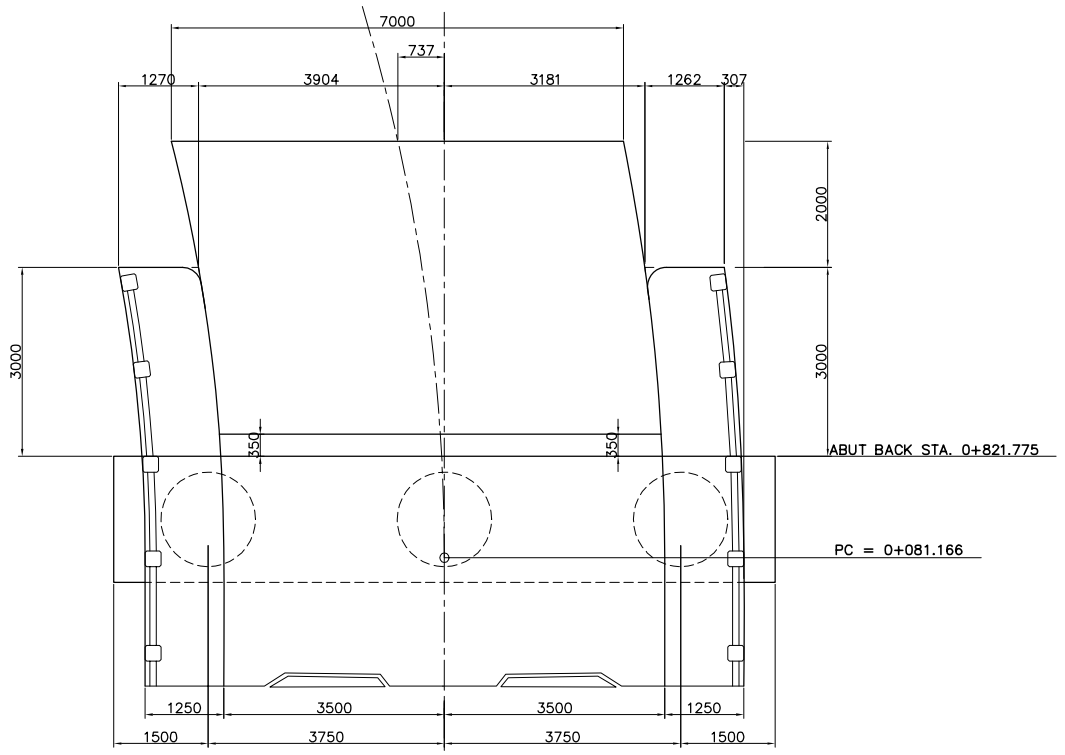
DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE SUBSTRUCTURE STRUCTURAL DIMENSION (ABUTMENT A1)	SCALE : AS SHOWN	DRAWING No: 1-4 Rev.



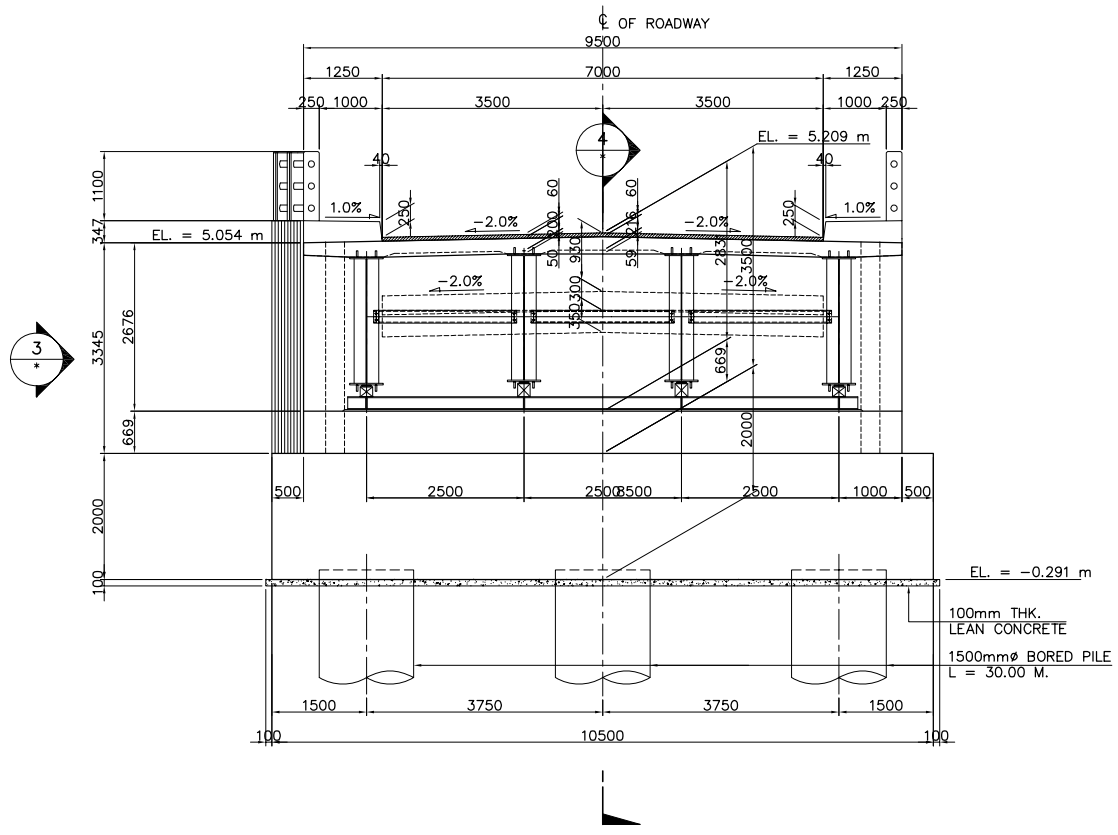
2 PLAN
- SCALE 1:60



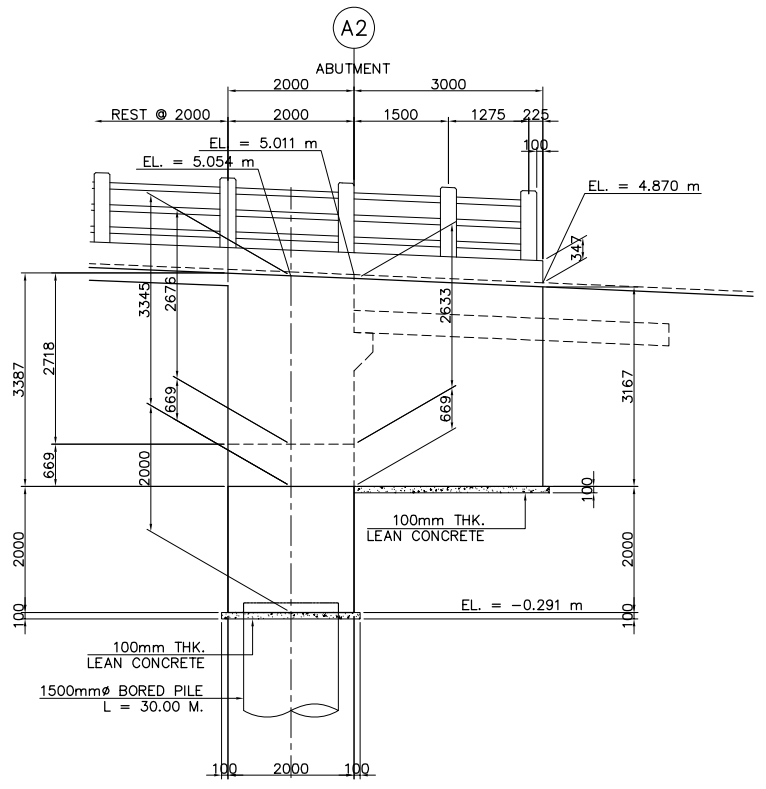
5 SECTION
- SCALE 1:20



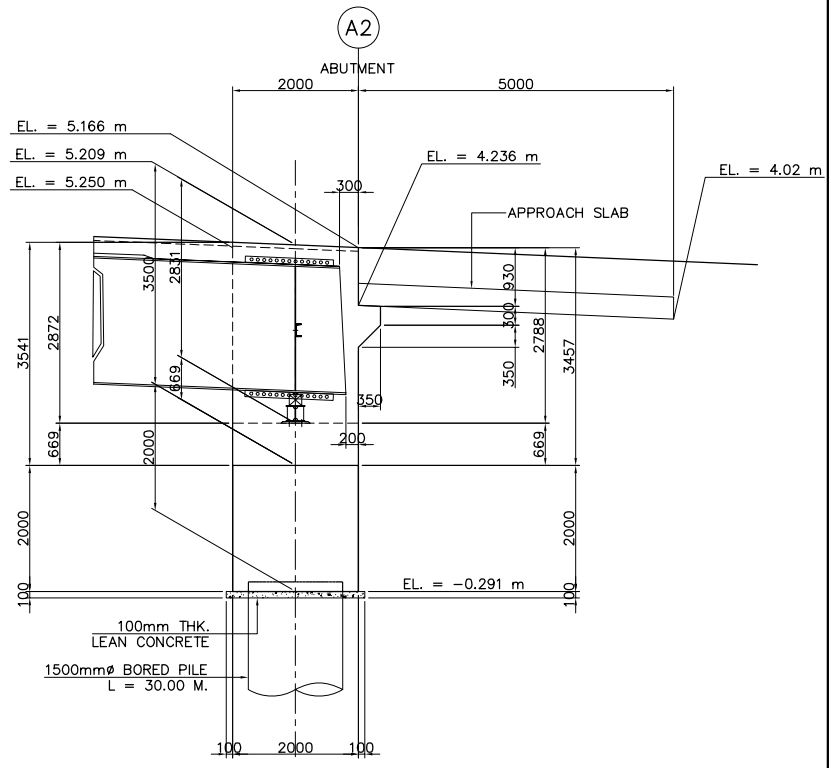
6 DIMENSION OF CURVATURE
- SCALE 1:60



1 SECTION
- SCALE 1:60

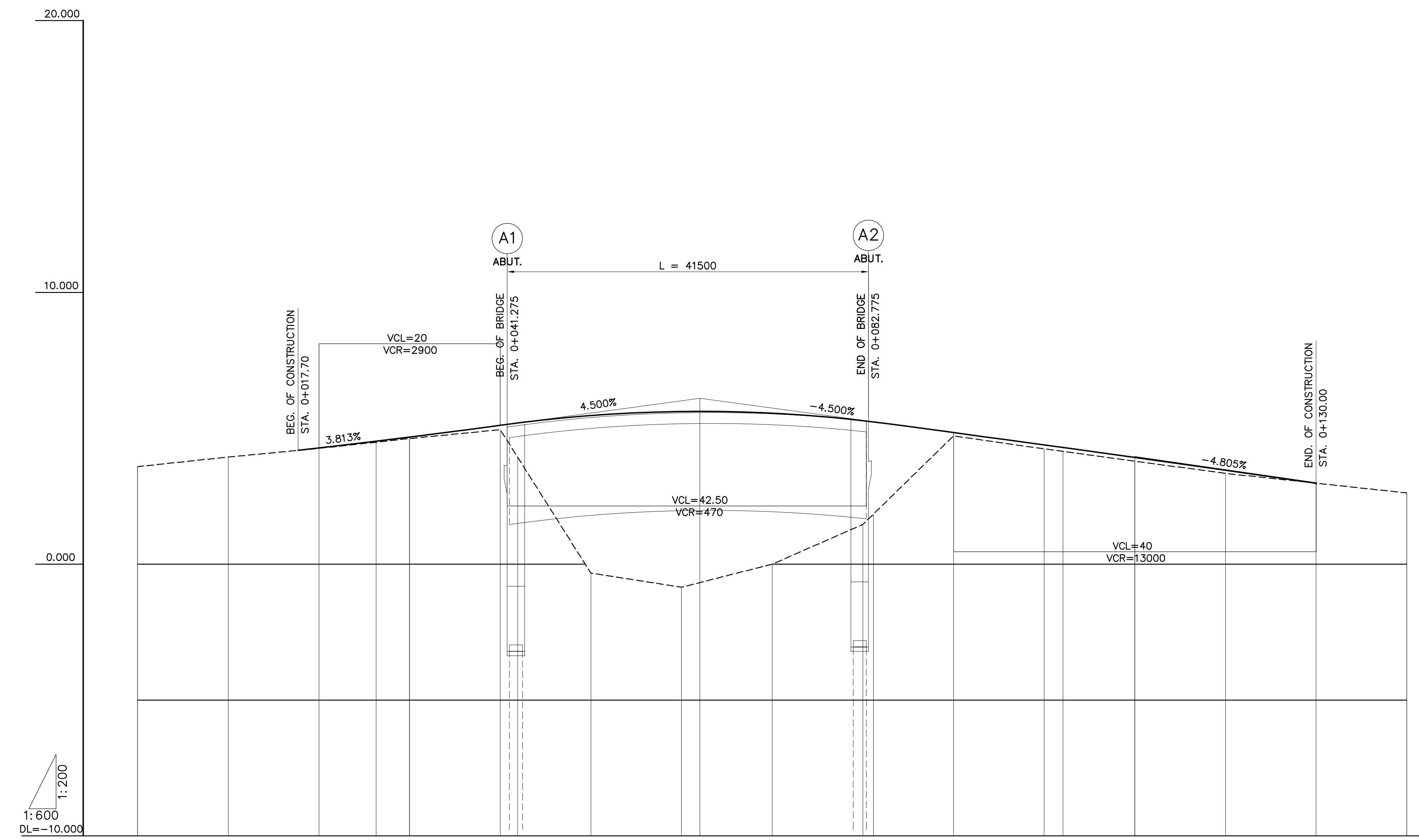


3 ELEVATION
- SCALE 1:60



4 SECTION
- SCALE 1:60

DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE SUBSTRUCTURE STRUCTURAL DIMENSION (ABUTMENT A2)	SCALE : AS SHOWN	DRAWING No: 1-5 Rev.



STATION	PAVEMENT LEVEL	GROUND LEVEL
BP	3.515	3.59
010.00	3.896	3.94
017.70	4.190	4.19
020.00	4.278	4.26
PC	4.525	4.49
030.00	4.676	4.62
040.00	5.109	4.95
PT	5.194	3.93
050.00	5.469	-0.33
060.00	5.618	-0.85
062.03	5.622	-0.68
070.00	5.555	0.00
080.00	5.280	1.46
PC	5.234	1.84
090.00	4.841	4.72
100.00	4.387	4.24
PT	4.292	4.15
110.00	3.926	3.79
120.00	3.457	3.34
130.00	2.980	2.98
140.00	2.499	2.62

VERTICAL ALIGNMENT: 4.190 — i=3.813% L=12.300 — 4.659 — i=4.500% L=32.025 — 6.100 — i=4.500% L=47.975 — 3.941 — i=4.805% L=20.000 — 2.980

HORIZONTAL ALIGNMENT: R=∞ L=26.30 — R=30 L=15.62 — R=∞ L=39.24 — R=30 L=20.92 — R=∞ L=38.21

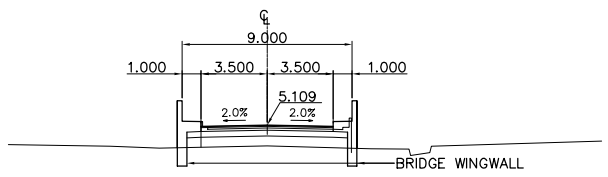
SUPER-ELEVATION

WIDENING

DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	KEI KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE APPROACH ROAD PROFILE	SCALE : H = 1:600 V = 1:200	DRAWING No: 1-6

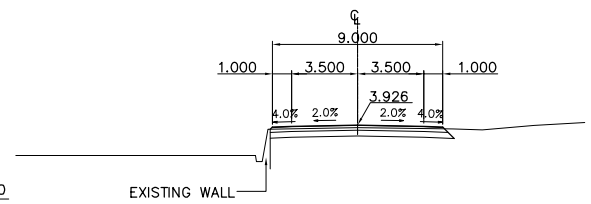
Rev.

NO.0K040.0000
GH=4.95
PH=5.109



DL=0.00

NO.0K110.0000
GH=3.79
PH=3.926



DL=0.00

NO.0K030.0000
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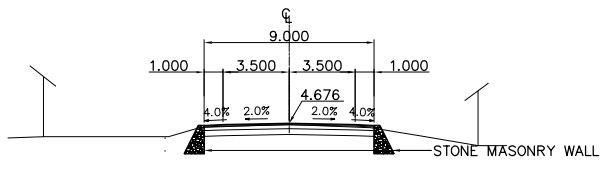
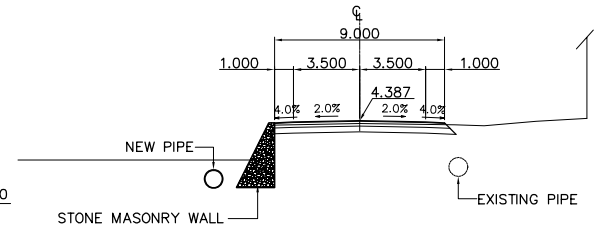
PH=4.676



DL=0.00

NO.0K100.0000
GH=4.24
PH=4.387



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NO.0K130 (EP)
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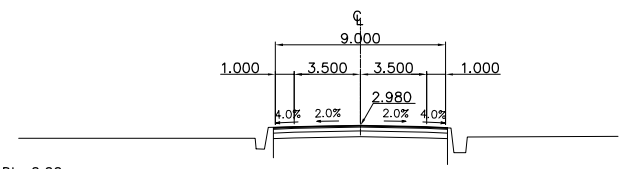
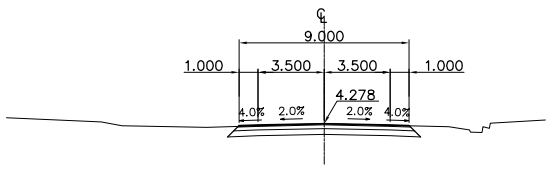
PH=2.980



DL=0.00

NO.0K020.0000
GH=4.26
PH=4.278



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NO.0K017.70 (BP)
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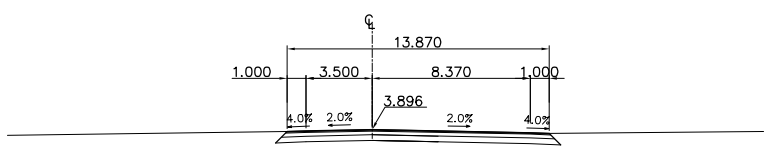
PH=4.190



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NO.0K090.0000
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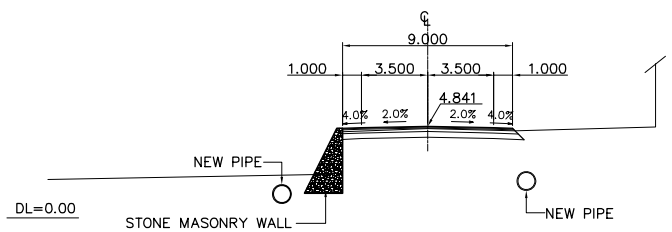

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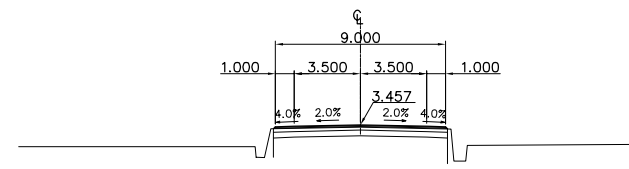
PH=3.457



DL=0.00

DIRECTORATE GENERAL OF HIGHWAY MINISTRY OF PUBLIC WORKS THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	KATAHIRA & ENGINEERS INTERNATIONAL	THE BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF BRIDGES IN NIAS ISLAND IN THE REPUBLIC OF INDONESIA	TITLE : NOU BRIDGE APPROACH ROAD CROSS SECTIONS	SCALE : 1 : 400	DRAWING No: 1-7