UNITED NATIONS

COMMITTEE FOR COORDINATION OF INVESTIGATIONS
OF THE LOWER MEKONG BASIN

NONG KHAI / VIENTIANE
BRIDGE PROJECT

LAOS AND THAILAND

EXAMINATION REPORT
OF THE REVISED
CONSTRUCTION COST ESTIMATE

OVERSEAS TECHNICAL COOPERATION AGENCY

Japan, July 1974

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PREFACE

The Japanease Government, in compliance with the request made by the Mekong Committee (MP/A.2271 TEC 322 (4-17) dated November 30, 1972) in connection with the Nongkhai/Vientiane Bridge Project, agreed to render technical cooperation for the investigation of the Project and entrusted the Overseas technical Cooperation Agency (hereinafter referred to as "OTCA").

The OTCA, in recognition of the importance of the Project in establishing a firm foundation for the economic and social development of both Thailand and Laos, organized a survey team of four Japanese experts head by Mr. Nobuichi Nomoto of the Ministry of Construction. The survey team was despatched to Thailand and Laos for a period of fifteen days from November 18, 1973. The field investigation was carried out successfully with the helpful cooperation given by officials concerned of the Mekong Committee and the Governments of Thailand and Laos.

In March 1974, the survey team submitted to the Mekong Committee the Draft Report containing the results of the examination on the revised construction cost estimate of the Scaled-down Plan for this project received from the Mekong Committee, based on the report concerned with the Nongkhai/ Vientiane Bridge Project previously submitted to the Mekong Committee in September 1969 by the OTCA. In addition, a cost estimate regarding the construction of an alternative concrete bridge under the Scaled-down Plan prepared by us was also attached to the report.

This report is to finalize the above-mentioned draft report in accordance with the decision by the Mekong Committee, and there have been no fundamental change to the conclusions reached in the draft report. We sincerely hope that this report will be useful for use as reference in the further study so as to realize this project as soon as possible.

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The survey team wishes to hereby express deep gratitude to the members of both Laotian and Thai Governments as well as the Mekong Committee who have extended kind cooperation and assistance and provided valuable data to the team, particularly to;

Laotian Government

Mr. Phak Savann	Directeur Général, Ministère des Travaux Publics et des Transports
Mr. Saykham	Directeur des Ponts & Chaussées Ministère des Travaux Publics et des Transports
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Mr. Sounthra Phandanouvong	Ingénieur an Service Technique

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Mr. Vibul Taweesup	Chief of the Mekong River Project National Energy Administration
Mr. Prasan Vandhanakom	Liaison Engineer National Energy Administration
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Mekong Secretariat

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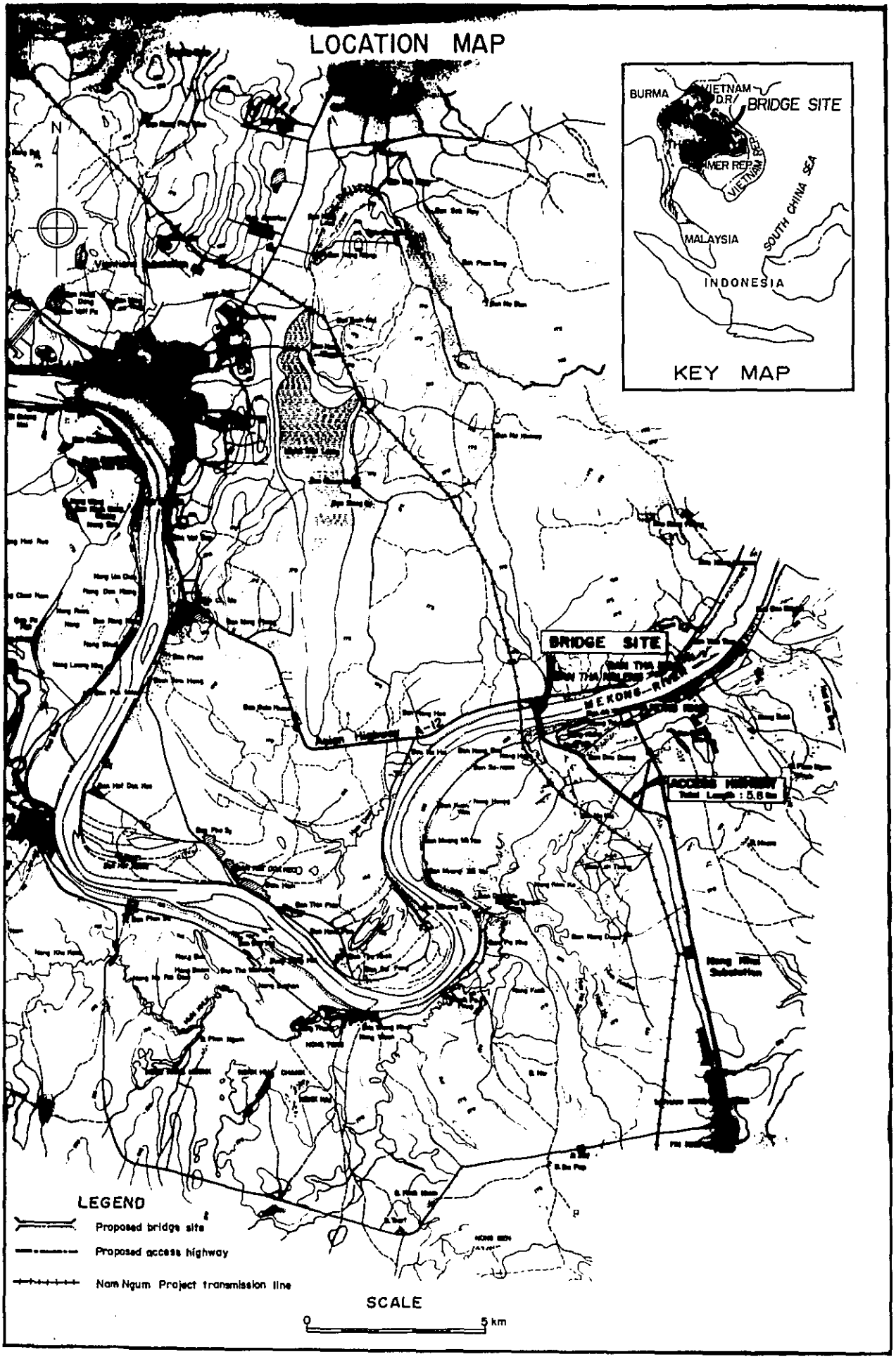
LOCATION MAP
N
BURMA
VIETNAM D.R.
BRIDGE SITE
VIETNAM REP.
SOUTH CHINA SEA
MALAYSIA
INDONESIA
KEY MAP
BRIDGE SITE
MEKONG RIVER
ACCESS HIGHWAY
Total Length : 5.6 km
LEGEND
Proposed bridge site
Proposed access highway
Nam Ngum Project transmission line
SCALE
0
5 km

OUTLINE OF SCALED-DOWN PLAN

Item		Description
I.	PROJECT	
	1. Location	600 kilometers northeast of Bangkok, 20 kilometers southeast of Vientiane and 3 kilometers upstream of Nong Khai
	2. Purpose	To build, across the Mekong, either a rail/highway bridge of which railway track can be constructed in future or a highway bridge, including all the highway facility.
II.	BRIDGE	
	1. Type	
	(i) Main bridge	9-span steel Warren truss continuous over 2 and 3 spans.
	(ii) Approach viaduct	Precast PC box girder
	2. Bridge width	17.8 m
	(i) Highway	8.0 m
	(ii) Sidewalk	1.5 m
	3. Bridge length	
	(i) Main bridge	650 m
	(ii) Approach viaduct	2x161.3 m
	4. Max. pier spacing	90 m
	5. Abutment and pier fundation	2 open caissons on both banks, and 8 pneumatic caissons in river channel
III.	HIGHWAY	
	1. Access highway	
	Length	5.8 km
	Width (i) Roadway	7 m (two lanes)
	(ii) Shoulders	2.5 m each
IV.	ADMINISTRATIVE FACILITIES	48,000 m^2

NONG KHAI/VIENTIANE BRIDGE PROJECT

EXAMINATION REPORT
OF THE REVISED CONSTRUCTION COST ESTIMATE

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EXAMINATION REPORT OF THE REVISED CONSTRUCTION COST ESTIMATE

§1 SUMMARY

This report contains the results of an examination of the revised construction cost estimate made by the Mekong Committee on the scaled-down plans for the Nongkhai/Vientiane Bridge Project. The scaled-down plans consist of the Case I (the rail/highway bridge plan under which a highway bridge be initially constructed) and the Case II (the highway bridge plan). Main structure in both cases is a 650 m. long multispan steel-truss bridge.

In November 1973, the Japanese governmental survey team carried out the field investigations in Thailand and Laos to examine the revised cost. After returning to Japan the survey team examined and analyzed the data collected and then newly estimated the construction cost. Both the costs revised before and estimated newly are summarized in Table 1.1. The total construction cost of Case I is nearly US$22.0 million though the previously revised cost is about US$9.8 million, and that of Case II is about US$17.1 million though previously revised to US$7.8 million.

These great differences are mainly due to 1) the world-wide price escalation since 1972 when the revised estimate was made, for example, the material price of steel became twice in these two years, and 2) the differences of basic standards or criteria applied at this time and at revised estimate.

Table 1.1 Comparative Construction Cost of Scaled-down Plan

Work	Construction Cost (US$)						Cause of difference
	Case I			Case II			
	Revised before	Estimated newly	Difference	Revised before	Estimated newly	Difference	
I. GOVERNMENTS' PREPARATORY WORKS	736,000	1,079,000	343,000	376,000	719,000	343,000	
1. Construction facilities	151,000	494,000	343,000	151,000	494,000	343,000	Diesel generators added
2. Land and rights	585,000	585,000	0	225,000	225,000	0	
II. MAIN CONSTRUCTION WORKS	6,295,064	14,477,000	8,181,936	5,220,946	11,443,000	6,222,054	
1. Main truss bridge	3,945,421	10,907,000	6,961,579	2,871,303	7,873,000	5,001,697	
(i) Superstructure	2,070,915	6,829,000	4,758,085	1,452,045	4,773,000	3,320,955	Price of truss member rose to 2.5 times
(ii) Substructure	1,874,506	4,078,000	2,203,494	1,419,258	3,100,000	1,680,742	Price of steel material rose to 20 times
2. Approach viaducts	230,791	584,000	353,209	230,791	584,000	353,209	- do -
3. Highway	956,775	1,216,000	259,225	956,775	1,216,000	259,225	Price of asphalt rose to 2 times
4. Administrative facilities	1,162,077	1,770,000	607,923	1,162,077	1,770,000	607,923	Price of timber & asphalt rose to 2 times
III. GOVERNMENTS' ADMINISTRATIVE EXPENSE	421,864	930,000	508,136	335,817	730,000	394,183	Direct cost rose as above.
IV. ENGINEERING SERVICE	769,845	1,900,000	1,130,155	590,727	1,431,000	840,273	- do -
V. CONTINGENCY AND RESERVE	1,054,659	2,334,000	1,279,341	839,542	1,817,000	977,458	- do -
VI. INTEREST DURING CONSTRUCTION	556,646	1,240,000	683,354	441,782	970,000	528,218	- do -
TOTAL	9,834,078	21,960,000	12,125,922	7,804,814	17,110,000	9,305,186	

§2. INTRODUCTION

2.1 Outline of the Scaled-down Plan

The project site is located on 20 kilometers southeast of Vientiane and 3 kilometers upstream of Nongkhai.

In 1972, the Mekong Committee prepared two scaled-down plans for this Project and revised the construction cost to reduce the initial investment thereof. The scaled-down plans consisted of Case I and Case II. The Case I is the plan of constructing a dual-purpose rail/highway bridge under which only the highway bridge and related highway facilities will initially be constructed to be provided for the future railway extension. The Case II is the plan of constructing a single-purpose highway bridge.

Each Case comprises four major parts; a main multispan steel-truss bridge with a length of 650 meters sustained by caisson foundations, 320-meter long approach viaducts of precast prestressed concrete girders, 5.8 kilometers long access highway and the administrative facilities in Thailand and Laos with a total area of 4.8 hectares. Width of the main truss bridge in the Case I will be 13.4 meters so as to provide both the highway floor and the space for future railway track on a through-truss bridge not separated though in the Case II 9.3 meters.

The Asian Highway Route A-12 which is now in service but interrupted by the Mekong will become motorable for its entire length upon completion of the bridge.

2.2 Examination Work

2.2.1 Scope of Work

OTCA, entrusted with the study of the scaled-down plan by the Japanese government, despatched a field survey team for 15 days from November 18, 1973.

The scope of work carried out by the survey team included; 1) gathering of necessary data and information for the cost estimate of the scaled-down plan, 2) gathering of opinions on this project from the officials concerned of the Laotian and Thai Governments as well as the Mekong Com-

mittee, 3) discussing in detail with the staff who actually made the revised estimate, 4) inspecting of the bridge construction site and 5) examining of the revised cost estimate after returning to Japan.

2.2.2 Field Survey Team

The field survey team is formed by the following four members.

Mr. Nobuichi NOMOTO	Head of the Team, Head of Second Road Planning Division, Chubu Regional Construction Bureau, Ministry of Construction
Mr. Hirokazu ITO	Highway Engineer, (Registered Consulting Engineer) Chief of Highway Department, Nippon Koei Co., Ltd.
Mr. Tohru ITO	Civil Engineer, Project Planning Department, Nippon Koei Co., Ltd.
Mr. Haruo SUZUKI	Liaison and Accounting Officer, Development Survey Department, Overseas Technical Cooperation Agency

§3 EXAMINATION OF THE REVISED COST

3.1 Minor Modification of Design

The survey team, after returning to Japan, studied on the bridge design of the scaled-down plan in parallel with examination work of the revised cost estimate, taking into consideration the advanced bridge engineering and the recent circumstances of the countries concerned. As the result of study it was confirmed that no basic revision or change on the design received from the Mekong Committee was required, except on some minor points as mentioned below.

- The 30-meter long composite girder bridge forming a part of the approach viaduct is considered to be not so severe in designing the joint of different types of bridge structures such as steel-truss and concrete girder. So, it is changed to more economical bridge structure, that is, precast, prestressed-concrete, multi-box-girder bridge with pier spacing of 16 meters, as shown in the attached PLATE 5.

- Sodding on side slopes of the highway embankment is provided for slope protection instead of soil-cement mixed embankment. The embankment soil is sufficiently stable even when it is saturated with water, according to experiences at other highway embankments by the authorities concerned of the Thai government.

- Total building area of temporary facilities for construction use is reduced to 1,000 sq. meters from 1,500 sq. meters which would be required for the simultaneous construction of both railway and highway bridges.

3.2 Examination of the Unit Prices

Main effort of the survey team was concentrated on this examination of the unit prices which were used in the revised cost estimate received from the Mekong Committee. Based on the data collected in the field survey and the current material price records of Japan, the unit prices are newly estimated at this time. Wages of labors and prices of material

domestically available are assessed in terms of Thai Baht and Laotian Kip but exchanged to US dollar at the rates of 20 Bahts and 500 Kips a dollar respectinely. Structural steel of truss members and sheet piles, etc., and heavy construction equipment such as a cable crane, traveller cranes, emergency power plants, aircompressors and hospital lock are assessed in the term of US dollar. Price escalation after now (Mar. 1974) is not taken into account in this estimate, but the import, commodity and other taxes are included.

Followings are the major unit prices assessed at this time and comments on the prices used in the revised cost estimate.

1) Structural steel for truss member

The unit price of 525 US dollars per ton of steel material for bridge, which was used in the revised cost estimate, is considered to be too cheap even though it was assessed two years ago. Such price is applicable only to a steel material to be used for some light-loading structures. Truss members of bridge are made of special high grade steel from which the weight of truss members had been calculated and require complicated fabrication and welding by skilled technicians.

The unit price estimated at this time is as follows:

Items	Unit price per ton (US$ equiv.)
Material including fabrication and painting:	1,000
Transportation:	130
Erection(including traveller and cable cranes and other equipment):	420
General expense	250
Total:	1,800

2) Concrete

Unit price of concrete in this estimate is based on the assumption that ready-mixed concrete with required qualities will be

purchased from a domestic company. The unit price of concrete, including forms, scaffoldings and placing equipment, vary according to the kind of particular structure. The estimated unit prices range from US$70 to 160 per m^3, for instance;

Items	Unit price per m^3	
	Caisson concrete (Cement 300 kg/m^3)	Pier concrete (Cement 250 kg/m^3)
	(US$ equiv.)	(US$ equiv.)
Concrete mixed and carried to site:	45	35
Forms and scaffolding:	50	20
Labors:	7	2
Chutes, conveyors, bucket and other equipment:	32	3
General expense:	26	10
Total:	160	70

3) Other steel

The import price of steel material such as reinforcement bar and sheet pile became twice or more at Bangkok for these two years, and accordingly the present unit prices including erection and other related costs are as follows;

- Reinforcement bar

Items	Unit price per ton
	(US$ equiv.)
Material	410
Inland transportation	10
Fabrication and erection	120
General expense	90
Total;	630

- Sheet pile

Items	Unit price per ton (US$ equiv.)
Materials	450
Inland transportation	10
Erection and driving	170
General expense	120
Total;	750

4) Excavation for pier foundations

The previously revised estimate classified the excavation cost of pier foundations into three classes according to types of caisson and compositions of soil, sand, gravel and rock to be excavated. Unit price of upper layer excavation of river bed and bank was US$7.5/$m^3$ in the rivesed estimate. The price is, however, considered to be too cheap to excavate under-water layers by using the open caisson that could be changed to the pneumatic caisson after reaching to gravel layer or bed rock. Special measures to dewater or special machines workable in water will additionally be required and their costs will exceed the labor cost for pneumatic caisson. Furthermore, if the big amount of pneumatic equipment cost is allotted to a little excavation volume only of shale and gravel, the unit price of gravel and shale excavation will increase greatly compared with US$30/$m^3$ in the revised estimate.

In this estimate cost of the pneumatic equipment is allotted to whole volume to be excavated by the pneumatic caissons regardless of soil or rock. Hence, the unit prices of excavation by the pneumatic caisson and the open caisson are estimated at US$35/$m^3$ and US$15/$m^3$ respectively.

5) Power supply for construction use

The unit price per kilometer of the power distribution line from the Nongkhai substation to the bridge site was newly estimated and resulted in US$6,000/km including the costs for material, equipment and wiring, which increased to three times from the revised

estimate. This is especially due to price escalation of material.

Substation equipment at the site, such as a 1,000 KVA transformer, cubicle and so on, will cost US$40,000 including installation cost, which is rather low than the revised estimate.

In addition, two Diesel power plants (500 KW + 250 KW) will be required for emergency use though these were eliminated in the revised estimate. Their costs will be approximately US$313,000.

§4 RE-ESTIMATE OF CONSTRUCTION COST

Based on the bridge design modified and new unit prices as described in the previous section 3, the construction costs of both Case I and Case II are estimated herein and tabulated in Tables 4.1 and 4.2 respectively. As seen in the tables, the cost of Case I includes compensation cost of land and right for the access railways to Vientiane to be constructed in the future. For easy comparisons, the revised estimates received from the Mekong Committee are concurrently presented in the tables.

Consequently, the total construction costs of Case I and Case II amount to US$21.96 million and US$17.11 million respectively whereas those were estimated at US$9.83 million and US$7.80 million respectively in the previously revised estimate.

The construction cost of main truss bridge including substructure increases to US$10.91 million from US$3.95 million of the revised estimate for Case I and to US$7.87 million from US$2.87 million for Case II. These newly estimated costs correspond US$16,800 and US$12,100 per meter of bridge length for Case I and Case II respectively.

Table 4.1 Itemized Comparative Construction Cost of Scaled-down Plan

(Case I)

Note: Quantities in ( ) show the quantities revised before.

Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated newly(US$) Unit Price	Estimated newly(US$) Amount	Difference(US$)	Remarks
I.	GOVERNMENTS PREPARATORY WORKS				736,000		1,079,000	343,000	
1.	Construction facilities				151,000		494,000	343,000	
(a)	Temporary buildings	m^2	1,000 (1,500)	40	60,000	40	40,000	-20,000	Offices and laboratory
(b)	Water supply system	L.S.			15,000		35,000	20,000	Well and pump
(c)	Electric power supply system								
c-1	22 kV distribution line	Km	8	2,000	16,000	6,000	48,000	32,000	22 kV distr. line 8 km long
c-2	Substation equipments	L.S.			50,000		40,000	-10,000	One 1,000 kVA trans. and others
c-3	Diesel power plants	L.S.			-		313,000	313,000	500 kW and 250 kW generators
(d)	Communication system	L.S.			10,000		18,000	8,000	One automatic telephone exchanger
2.	Land and rights	Km^2	1.3	450,000	585,000	450,000	585,000	-	
II.	MAIN CONSTRUCTION WORKS				6,295,064		14,477,000	8,181,936	
1.	Bridge				4,176,212		11,491,000	7,314,788	650 m long
(a)	Main truss bridge				3,945,421		10,907,000	6,961,579	
	Superstructure				2,070,915		6,829,000	4,758,085	
a-1	Steel for truss members	ton	3,320	525	1,743,000	1,800	5,976,000	4,233,000	
a-2	Concrete	m^3	2,250	40	90,000	80	180,000	90,000	Cement 300 kg/m^3
a-3	Reinforcement steels	ton	500	250	125,000	630	315,000	190,000	
a-4	Asphalt pavement	m^2	7,150	2	14,300	4	28,600	14,300	
a-5	Miscellaneous	L.S.			98,615		329,400	230,785	5 %
	Substructure				1,874,506		4,078,000	2,203,494	
a-6	Excavation for pier, Class I	m^3	6,575	7.5	49,311	15	98,625	49,314	2 piers
	Class II	m^3	6,245	7.5	46,845	35	218,575	171,730	8 piers
	Class III	m^3	2,680	30	80,388	35	93,800	13,412	8 piers
a-7	Cutting edge steels for caissons	No.	10		-	4,050	40,500	40,500	4.5 ton edge
a-8	Concrete for pneumatic caissons	m^3	6,200 (8,200)	60	492,000	160	992,000	500,000	Cement 300 kg/m^3
a-9	Concrete for open caissons	m^3	2,000		-	140	280,000	280,000	Cement 300 kg/m^3
a-10	Concrete for piers	m^3	6,700	50	335,000	70	469,000	134,000	Cement 250 kg/m^3
a-11	Reinforcement steels	ton	1,100	250	275,000	630	693,000	418,000	
a-12	Steel sheetpiles	ton	750	350	262,500	750	562,500	300,000	74 kg/m

Table 4.1 (Continued)

Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated newly(US$) Unit Price	Estimated newly(US$) Amount	Difference (US$)	Remarks
a-13	Structural steel for temporary bridge	ton	200	320	64,000	700	140,000	76,000	H-shape
a-14	Wooden mattresses for pier protection	m^2	6,200	21	130,200	40	248,000	117,880	
a-15	Gabions for bank protection	m^2	1,000	50	50,000	85	85,000	35,000	
a-16	Miscellaneous	L.S.			89,262		157,000	67,738	5 %
(b)	Approach viaduct (Composite girder bridges for highway)				230,791 (72,188)		584,000 -	353,209 (-72,188)	
b-1	Steel for composite girders	ton	90	525	47,250		-	-47,250	
b-2	Concrete	m^3	200	40	8,000		-	-8,000	
b-3	Reinforcement steels	ton	50	250	12,500		-	-12,500	
b-4	Asphalt pavement	m^2	500	2	1,000		-	-1,000	
b-5	Miscellaneous	L.S.			3,438		-	-3,438	5 %
	(Precast PC box girder bridge for highway)				(158,603)		(584,000)	(425,397)	2 x 161.3 m long
b-6	Excavation, common, for piers	m^3	1,850 (100)	1.5	150	2	3,700	3,550	
b-7	Concrete for superstructure	m^3	1,800 (1,300)	40	52,000	160	288,000	236,000	Cement 350 kg/m^3
b-8	Concrete for substructure	m^3	850 (200)	35	7,000	70	59,500	52,500	Cement 250 kg/m^3
b-9	Reinforcement steels	ton	80 (190)	250	47,500	630	50,400	2,900	
b-10	Concrete piles for piers	No.	300 (160)	250	40,000	300	90,000	50,000	
b-11	Asphalt pavement	m^2	2,580 (2,200)	2	4,400	4	10,320	5,920	
b-12	Miscellaneous	L.S.			7,553		82,080	74,527	5 %
2.	Highway				956,775		1,216,000	259,225	5.6 km long
2-1	Clearing and stripping	m^2	72,500	0.3	21,750	0.05	3,625	-18,125	
2-2	Excavation, common	m^3	26,500	1	26,500	1	26,500	-	
2-3	Embankment, earth	m^3	104,100 (59,800)	2	119,600	2	208,200	88,600	Including sodding
2-4	Embankment, soil-cement mix	m^3	44,300	6	265,800	-	-	-265,800	
2-5	Subbase course	m^2	47,450	3	142,350	3	142,350	-	
2-6	Base course	m^2	38,850	1.5	58,275	3.5	135,975	77,700	
2-7	Asphalt pavement	m^2	44,520	2	89,040	4	178,080	89,040	
2-8	Concrete for box culverts	m^3	2,300	40	92,000	80	184,000	92,000	Cement 280 kg/m^3

Table 4.1 (Continued)

Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated newly(US$) Unit Price	Estimated newly(US$) Amount	Difference (US$)	Remarks
2-9	Reinforcement steels	tons	230	250	57,300	630	144,900	87,400	
2-10	Guardrail	m	3,840		38,400	35	134,400	96,000	
2-11	Miscellaneous	L.S.			45,560		57,970	12,410	5 %
3.	Administrative facilities				1,162,077		1,770,000	607,923	
3-1	Clearing and stripping	m^2	50,300	0.3	15,090	0.1	5,030	-10,060	
3-2	Embankment	m^3	73,900	1.5	110,850	2	147,800	36,950	
3-3	Subbase course	m^2	39,700	3	119,100	3	119,100	-	
3-4	Base course	m^2	41,600	1.5	62,400	3.5	145,600	83,200	
3-5	Asphalt pavement	m^2	39,650	2	79,300	4	158,600	79,300	
3-6	Immigration offices and customhouses	m^2	6,500	90	585,000	120	780,000	195,000	
3-7	Warehouses, booths and others	m^2	3,000	45	135,000	110	330,000	195,000	
3-8	Miscellaneous	L.S.			55,337		83,870	28,533	5 %
III.	GOVERNMENTS' ADMINISTRATIVE EXPENSE	L.S.			421,864		930,000	508,136	6 % of (I) and (II)
V.	ENGINEERING SERVICE	L.S.			769,845		1,900,000	1,130,155	5 % of (I), 15% of (II) -1(a), 7 % of (II) - 1(b), 7 % of (II) - 2 5 % of (II) - 3
V.	CONTENGENCY AND RESERVE	L.S.			1,054,659		2,334,000	1,279,341	15 % of (I) and (II)
VI.	INTEREST DURING CONSTRUCTION	L.S.			556,646		1,240,000	683,354	6 % of (I) to (V)
	Total				9,834,078		21,960,000	12,125,922	

Table 4.2 Itemized Comparative Construction Cost of Scaled-down Plan
(Case II)

Note: Quantities in ( ) show the quantities revised before.

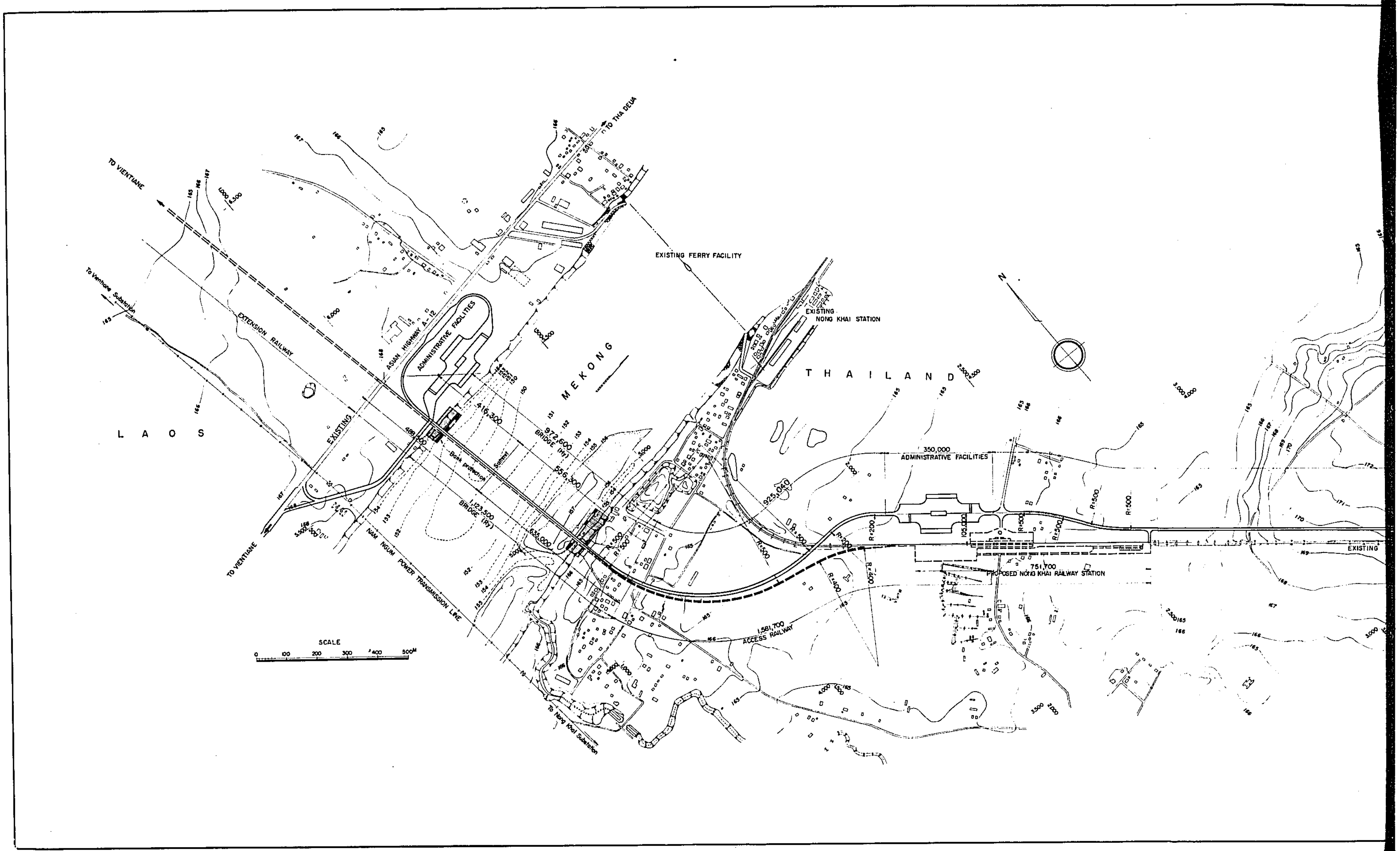
Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated Newly(US$) Unit Price	Estimated Newly(US$) Amount	Difference (US$)	Remarks
I.	GOVERNMENTS' PREPARATORY WORKS				376,000		719,000	343,000	
1.	Construction facilities				151,000		494,000	343,000	
(a)	Temporary buildings	m^2	1,000 (1,500)	40	60,000	40	40,000	-20,000	Offices and laboratory
(b)	Water supply system	L.S.			15,000		35,000	20,000	Well and pump
(c)	Electric power supply system								
	c-1 22 kV distribution line	km	8	2,000	16,000	6,000	48,000	32,000	22 kV distri. line 8 km long
	c-2 Substation equipments	L.S.			50,000		40,000	-10,000	One 1,000 kVA trans and others
	c-3 Diesel power plants	L.S.			-		313,000	313,000	560 kW and 250 kW generators
(d)	Communication system	L.S.			10,000		18,000	8,000	One automatic telephone exchanger
2.	Land and rights	km^2	0.5	450,000	225,000	450,000	225,000	-	
II.	MAIN CONSTRUCTION WORKS				5,220,946		11,443,000	6,222,054	
1.	Bridge				3,102,094		8,457,000	5,354,906	650 m long
(a)	Main truss bridge				2,871,303		7,873,000	5,001,697	
	Superstructure				1,452,045		4,773,000	3,320,955	
	a-1 Steel for truss members	ton	2,220	525	1,165,500	1,800	4,050,000	2,884,500	
	a-2 Concrete	m^3	2,140	40	85,600	80	171,200	85,600	Cement 300 kg/m^3
	a-3 Reinforcement steels	ton	470	250	117,500	630	296,100	178,600	
	a-4 Asphalt pavement	m^2	7,150	2	14,300	4	28,600	14,300	
	a-5 Miscellaneous	L.S.			69,145		227,100	157,955	5 %
	Substructure				1,419,258		3,100,000	1,680,742	
	a-6 Excavation for piers, Class I	m^3	3,700	7.5	27,750	15	55,500	27,750	2 piers
	Class II	m^3	3,500	7.5	26,325	35	122,850	96,525	8 piers
	Class III	m^3	1,510	30	45,300	35	52,850	7,550	8 piers
	a-7 Cutting edge steels for caissons	No.	10		-	3,800	38,000	38,000	3.8 ton edge
	a-8 Concrete for pneumatic caissons	m^3	3,310 (4,910)	60	294,600	160	529,600	235,000	Cement 300 kg/m^3
	a-9 Concrete for open caissons	m^3	1,600		-	140	224,000	224,000	Cement 300 kg/m^3
	a-10 Concrete for piers	m^3	4,520	50	226,000	70	316,400	90,400	Cement 250 kg/m^3
	a-11 Reinforcement steels	ton	900	250	225,000	630	567,000	342,000	
	a-12 Steel sheetpiles	ton	750	350	262,500	750	562,500	300,000	74 kg/m
	a-13 Structural steel for temporary bridge	ton	200	320	64,000	700	140,000	76,000	H-shape
	a-14 Wooden mattresses for pier protection	m^2	6,200	21	130,200	40	248,000	117,800	
	a-15 Gabions for bank protection	m^2	1,000	50	50,000	85	85,000	35,000	

Table 4.2 (Continued)

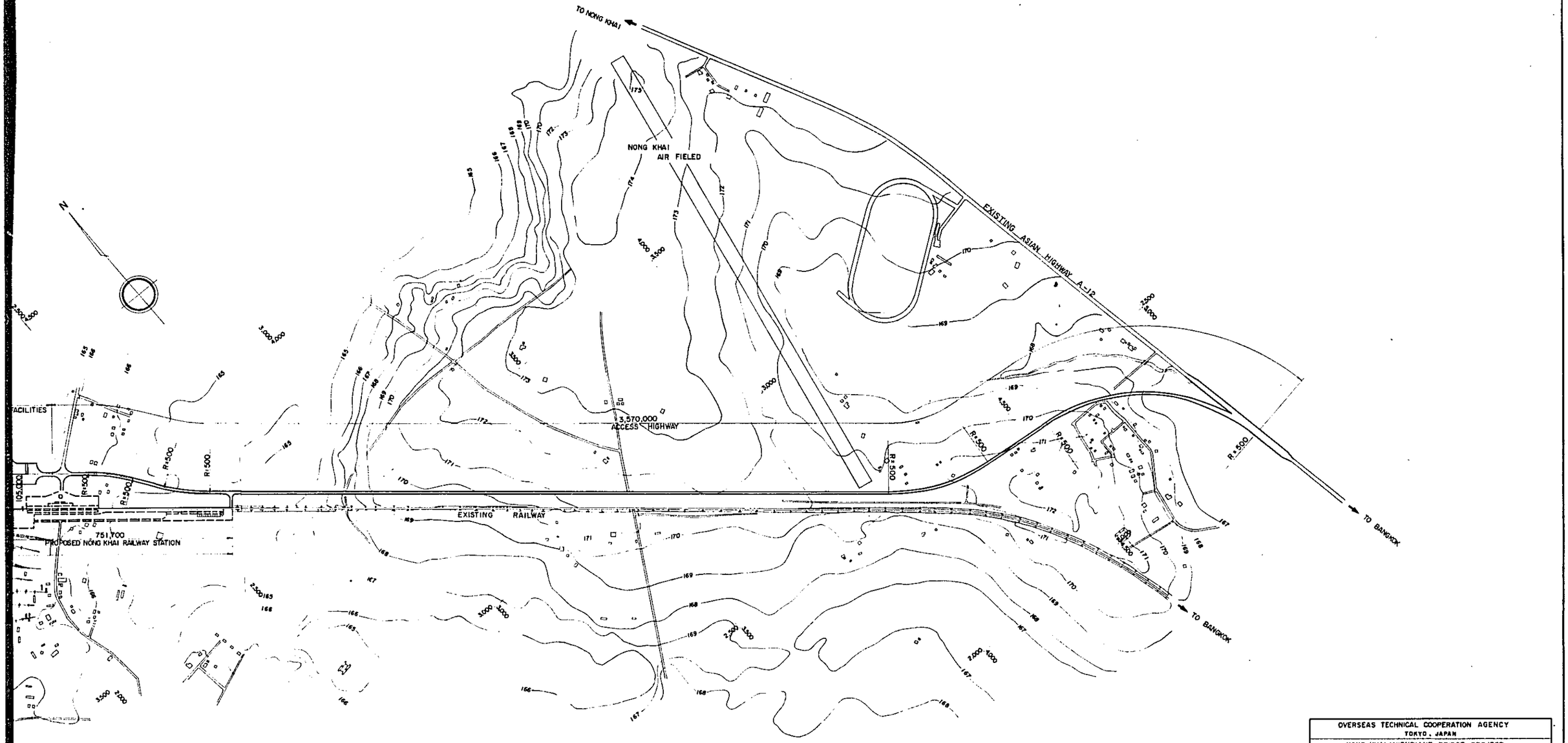
Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated Newly(US$) Unit Price	Estimated Newly(US$) Amount	Difference (US$)	Remarks
	a-16 Miscellaneous	L.S.			67,583		158,300	90,717	5 %
	(b) Approach viaducts (composite girder bridges for highway)				230,791 (72,188)		584,000 -	353,209 (-72,188)	
	b-1 Steel for composite girder	ton	90	525	47,250		-	-47,250	
	b-2 Concrete	m^3	200	40	8,000		-	-8,000	
	b-3 Reinforcement steel	ton	50	250	12,500		-	-12,500	
	b-4 Asphalt pavement	m^2	500	2	1,000		-	-1,000	
	b-5 Miscellaneous	L.S			3,438		-	-3,438	
	(Precast PC box girder bridge for highway)				(158,603)		(584,000)	(425,397)	2 x 161.3 m long
	b-6 Excavation, common, for piers	m^3	1,850 (100)	1.5	150	2	3,700	3,550	
	b-7 Concrete for superstructure	m^3	1,800 (1,300)	40	52,000	160	288,000	236,000	Cement 350 kg/m^3
	b-8 Concrete for substructure	m^3	850 (200)	35	7,000	70	59,500	52,500	Cement 250 kg/m^3
	b-9 Reinforcement steels	ton	80 (190)	250	47,500	630	50,400	2,900	
	b-10 Concrete piles for piers	No.	300 (1060)	250	40,000	300	90,000	50,000	
	b-11 Asphalt pavement	m^2	2,580 (2,200)	2	4,400	4	10,320	5,920	
	b-12 Miscellaneous	L.S.			7,553		82,080	74,527	5 %
2.	Highway				956,775		1,216,000	259,225	5.6 km long
	2-1 Clearing and stripping	m^2	72,500	0.3	21,750	0.05	3,625	-18,125	
	2-2 Excavation, common	m^3	26,500	1	26,500	1	26,500	-	
	2-3 Embankment, earth	m^3	104,100 (59,800)	2	119,600	2	208,200	88,600	Including sodding
	2-4 Embankment, soil-cement mix	m^3	44,300	6	265,800		-	-265,800	
	2-5 Subbase course	m^2	47,450	3	142,350	3	142,350	-	
	2-6 Base course	m^2	38,850	1.5	58,275	3.5	135,975	77,700	
	2-7 Asphalt pavement	m^2	44,520	2	89,040	4	178,080	89,040	
	2-8 Concrete for box culverts	m^3	2,300	40	92,000	80	184,000	92,000	Cement 280 kg/m^3
	2-9 Reinforcement steels	ton	230	250	57,500	630	144,900	87,400	
	2-10 Guardrail	m	3,840	10	38,400	35	134,400	96,000	
	2-11 Miscellaneous	L.S.			45,560		57,970	12,410	5 %
3.	Administrative facilities				1,162,077		1,770,000	607,923	
	3-1 Clearing and stripping	m^2	50,300	0.3	15,090	0.1	5,030	-10,060	
	3-2 Embankment	m^3	73,900	1.5	110,850	2	147,800	36,950	
	3-3 Subbase course	m^2	39,700	3	119,100	3	119,100	-	

Table 4.2 (Continued)

Item No.	Work	Unit	Quantity	Revised before (US$) Unit Price	Revised before (US$) Amount	Estimated Newly(US$) Unit Price	Estimated Newly(US$) Amount	Difference (US$)	Remarks
	3-4 Base course	m^2	41,600	1.5	62,400	3.5	145,600	83,200	
	3-5 Asphalt pavement	m^2	39,650	2	79,300	4	158,600	79,300	
	3-6 Immigration offices and customhouses	m^2	6,500	90	585,000	120	780,000	195,000	
	3-7 Warehouses, booths and others	m^2	3,000	45	135,000	110	330,000	195,000	
	3-8 Miscellaneous	L.S.			55,337		83,870	28,533	5 %
III.	GOVERNMENTS' ADMINISTRATIVE EXPENSE	L.S.			335,817		730,000	394,183	6 % of (I) and (II)
IV.	ENGINEERING SERVICE	L.S.			590,727		1,431,000	840,273	5 % of (I), 15 % of (II) - 1(a), 7 % of (II) - 1(b), 7 % of (II) - 2 5 % of (II) - 3
V.	CONTENGENCY AND RESERVE	L.S.			839,542		1,817,000	977,458	15 % of (I) and (II)
VI.	INTEREST DURING CONSTRUCTION	L.S.			441,782		970,000	528,218	6 % of (I) to (V)
	Total				7,804,814		17,110,000	9,305,186	



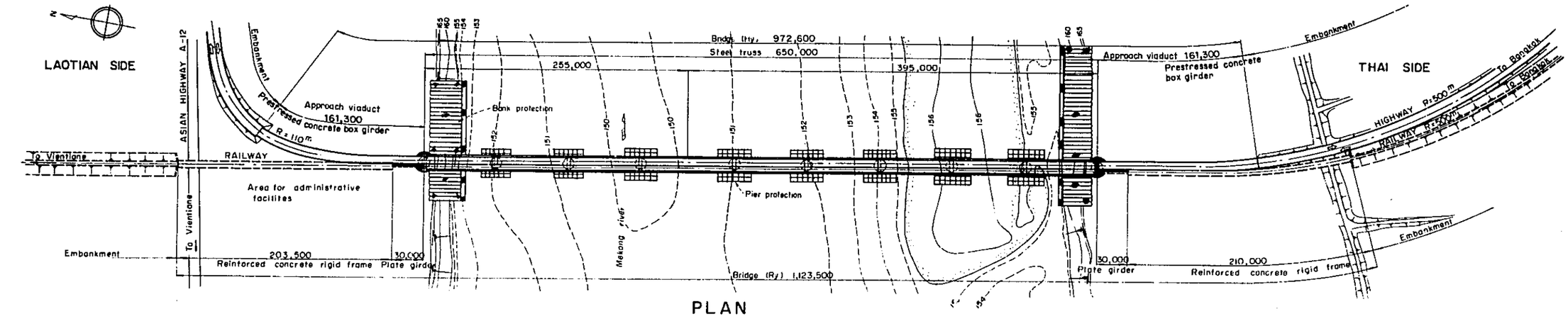
TO VIENTIANE
TO THA DEUA
To Vientiane Substation
EXISTING FERRY FACILITY
EXISTING NONG KHAI STATION
N
LAOS
THAILAND
MEKONG
ADMINISTRATIVE FACILITIES
ASIAN HIGHWAY A-12
EXISTING
EXTENSION RAILWAY
416,300
972,600
BRIDGE (Hy)
556,300
1,123,500
BRIDGE (Ry)
Bank protection
Summit
925,040
350,000
ADMINISTRATIVE FACILITIES
105,000
751,700
PROPOSED NONG KHAI RAILWAY STATION
EXISTING
1,581,700
ACCESS RAILWAY
NAM NGUM POWER TRANSMISSION LINE
TO VIENTIANE
To Nong Khai Substation
SCALE
0 100 200 300 400 500M



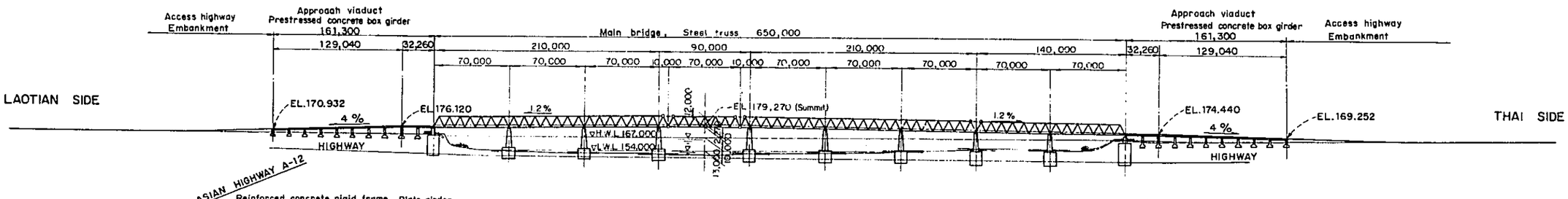
NOTE :

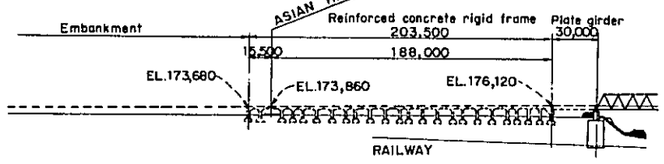
===== Future extension railway

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO, JAPAN	
NONG KHAI / VIENTIANE BRIDGE PROJECT	
GENERAL LAYOUT	
NIPPON KOEI CO. LTD. TOKYO (CONSULTING ENGINEERS)	
DRAWN	DATE
CHECKED	
SUBMITTED	PLATE 1
APPROVED	

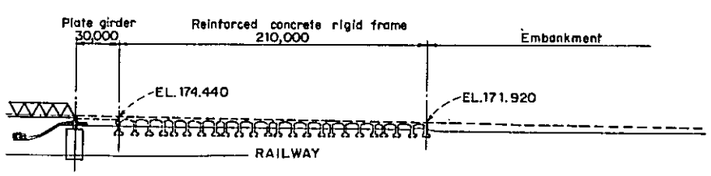


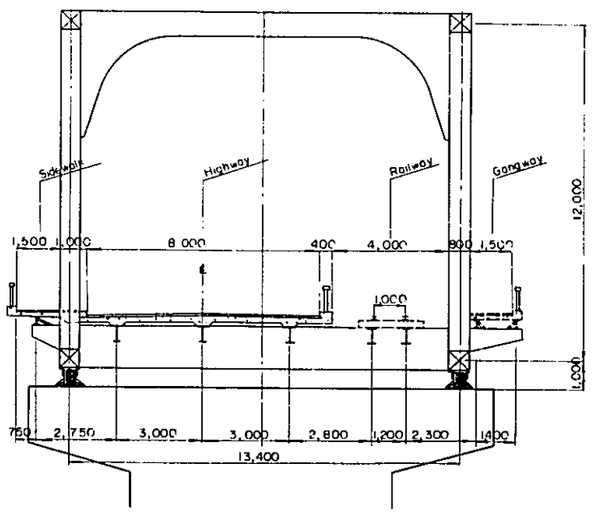
PLAN





PROFILE





TYPICAL CROSS SECTION
OF MAIN BRIDGE SUPERSTRUCTURE
(View from Liotion side)

NOTE:

:::::: Future extension railway

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

NONG KHAI / VIENTIANE BRIDGE PROJECT

BRIDGE PROFILE AND MAIN BRIDGE SUPERSTRUCTURE

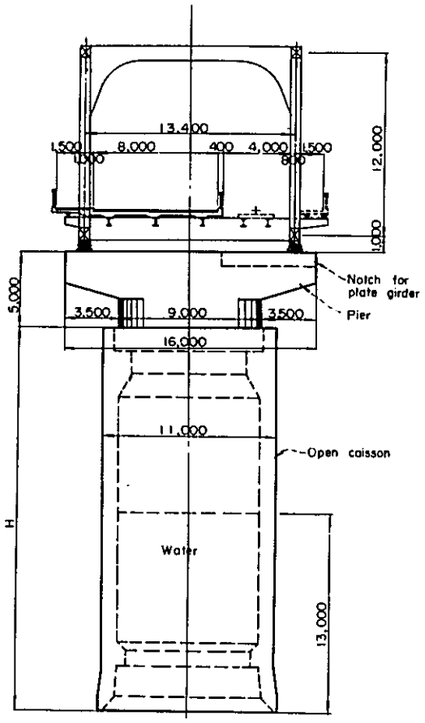
NIPPON KOEI CO., LTD. TOKYO
(CONSULTING ENGINEERS)

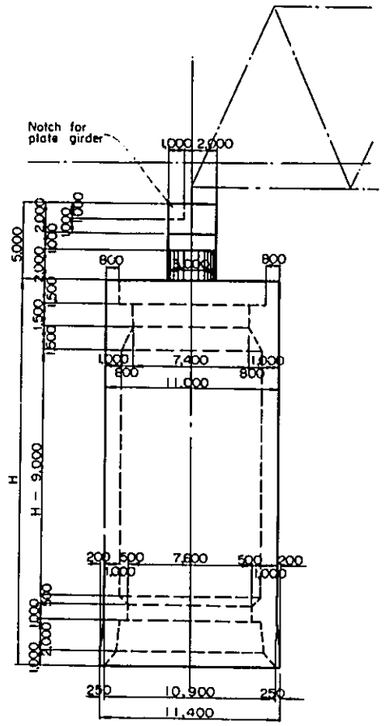
DRAWN
CHECKED
SUBMITTED
APPROVED

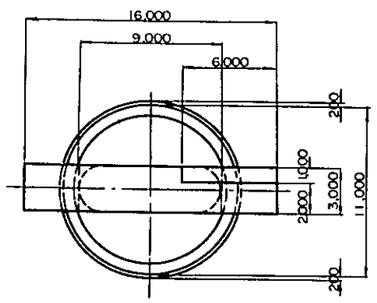
DATE

PLATE 2

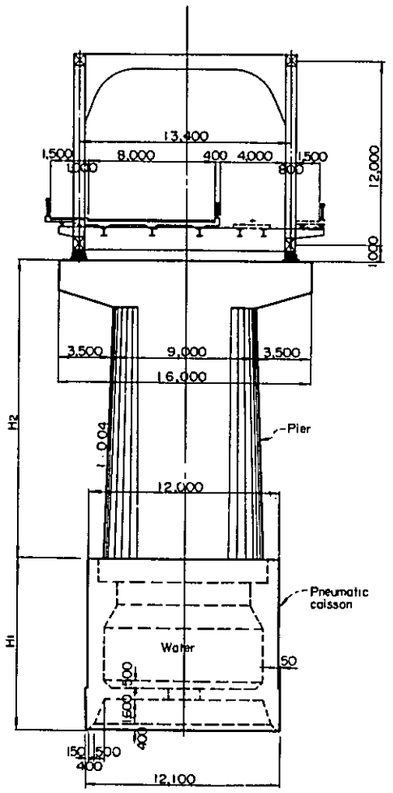
PIER AND OPEN CAISSON

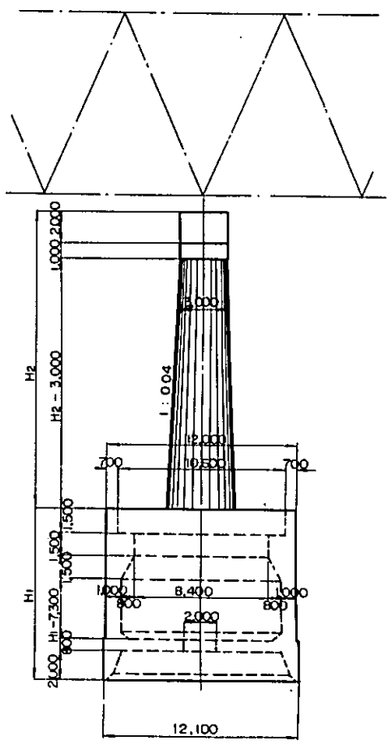


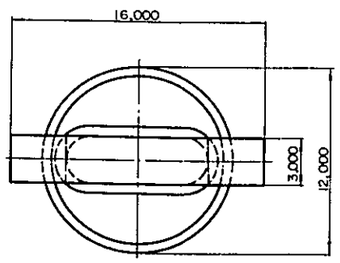




PIER AND PNEUMATIC CAISSON







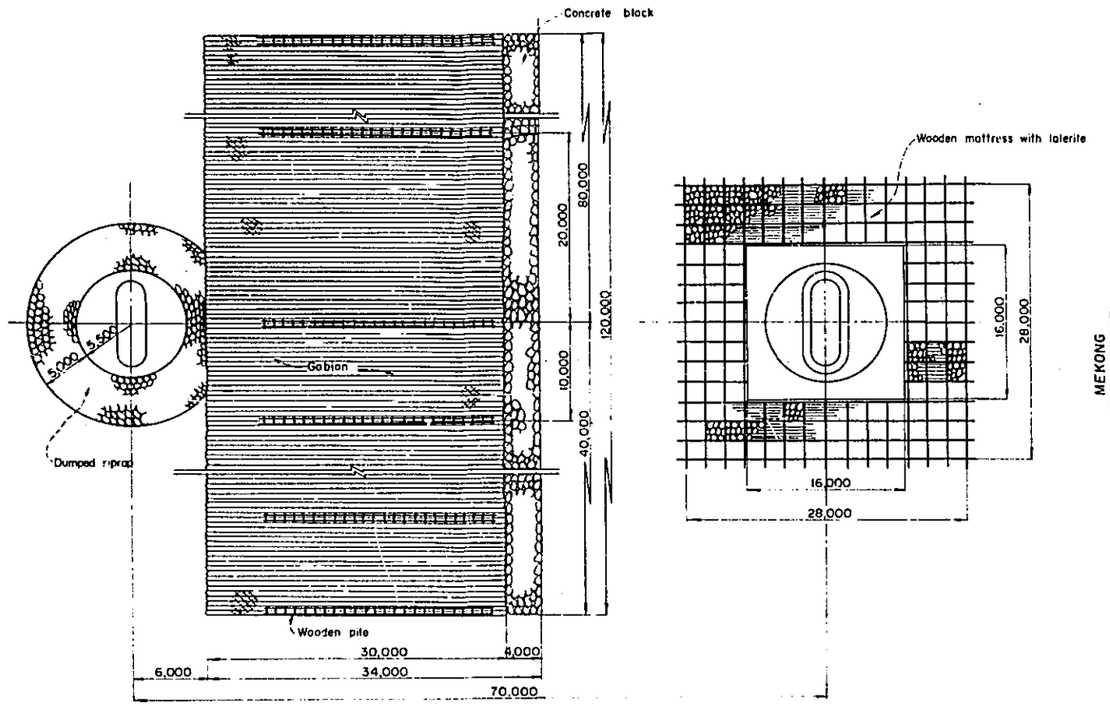
SCALE

0 10 20m

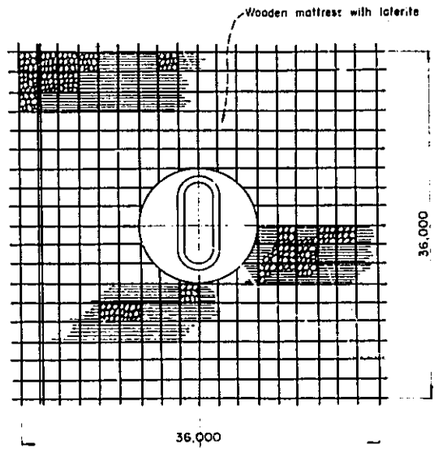
Remarks

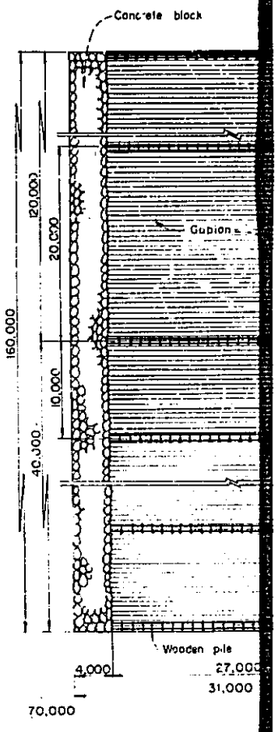
Both open and pneumatic caissons are planned to be founded on the fresh siltstone excavated its 2-meter surface.

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO, JAPAN	
NONG KHAI / VIENTIANE BRIDGE PROJECT	
MAIN BRIDGE SUBSTRUCTURE	
NIPPON KOEI CO., LTD. TOKYO (CONSULTING ENGINEERS)	
DRAWN CHECKED SUBMITTED APPROVED	DATE ..... PLATE 3

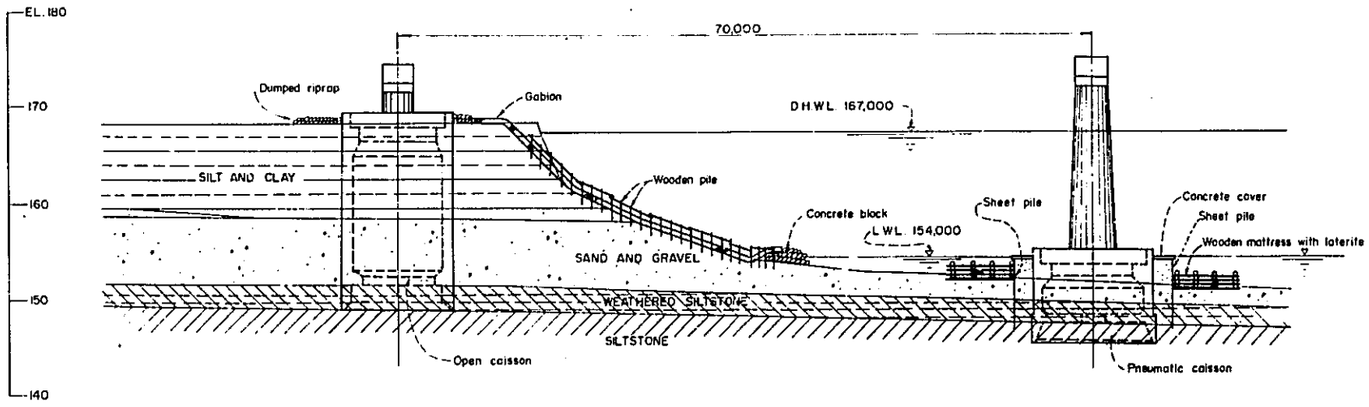


MEKONG

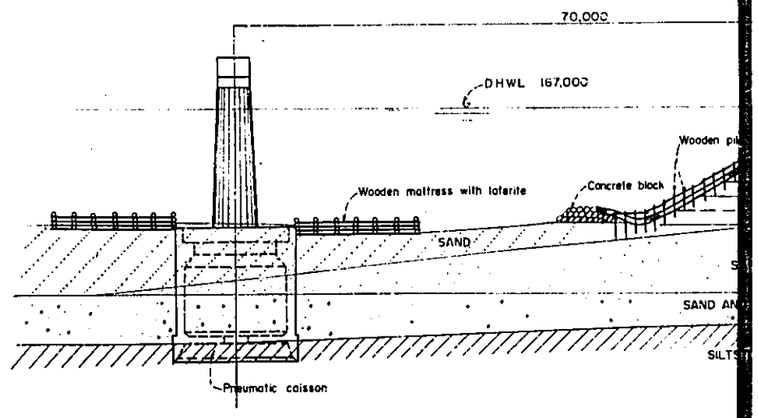




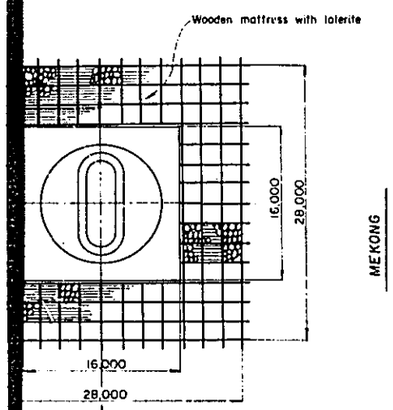
PLAN

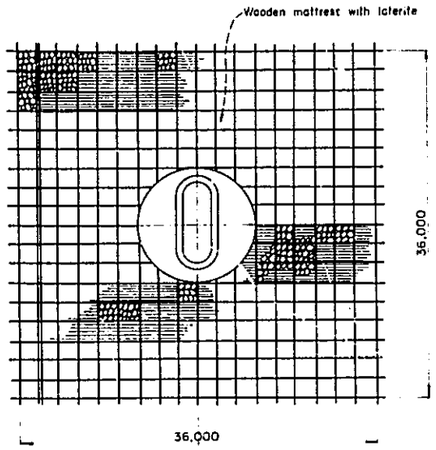


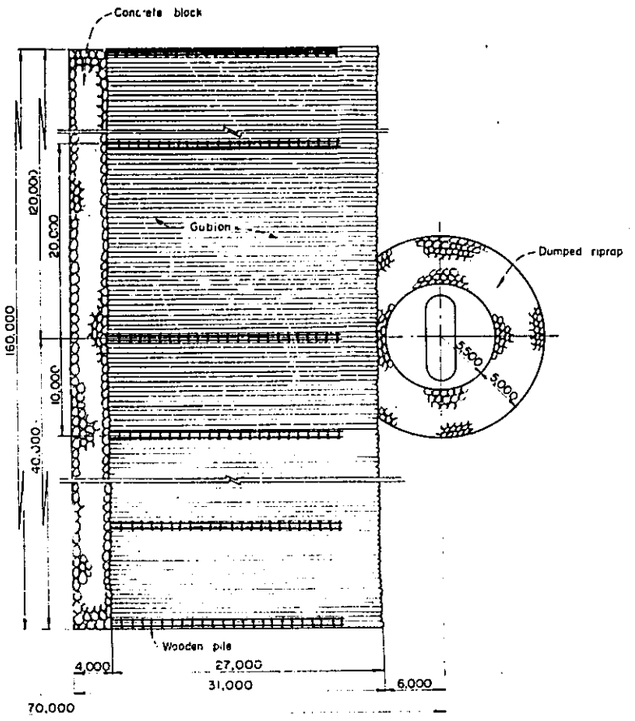
LAOTIAN SIDE



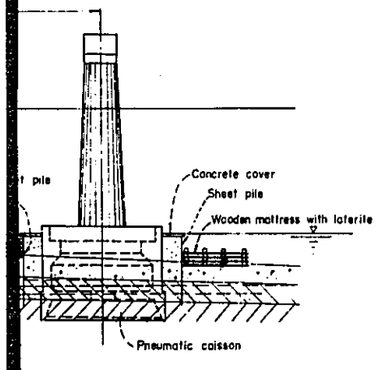
PROFILE

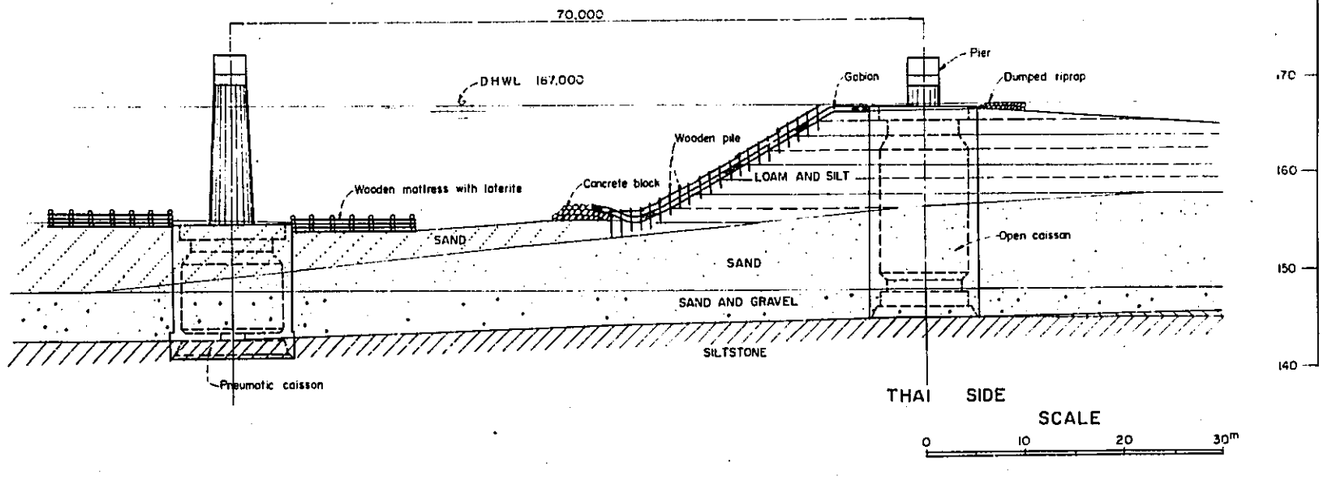






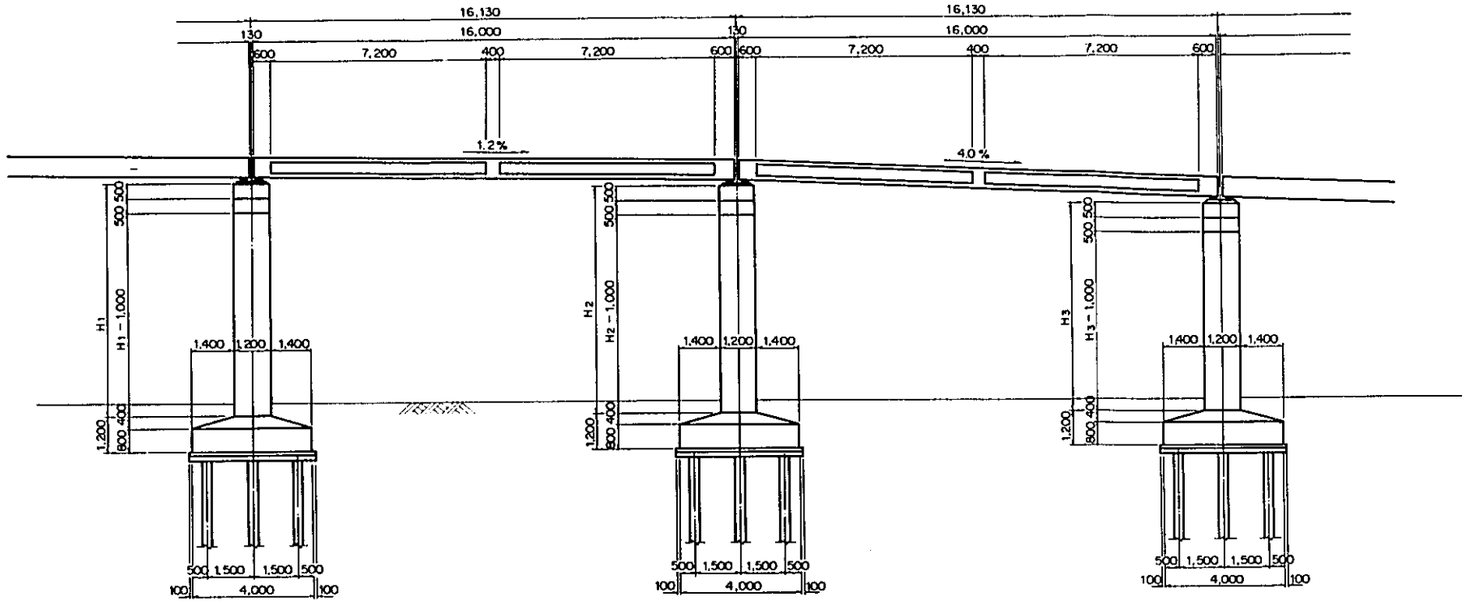
PLAN



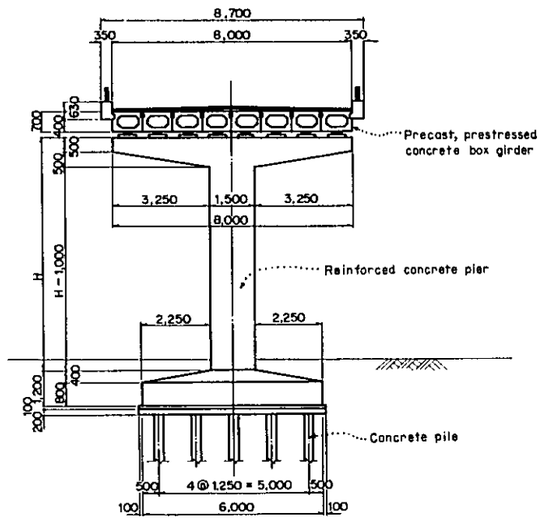


PROFILE

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO, JAPAN	
NONG KHAI / VIENTIANE BRIDGE PROJECT	
PIER AND BANK PROTECTIONS	
NIPPON KOEI CO., LTD. TOKYO (CONSULTING ENGINEERS)	
DRAWN	DATE
CHECKED	
SUBMITTED	
APPROVED	PLATE 4



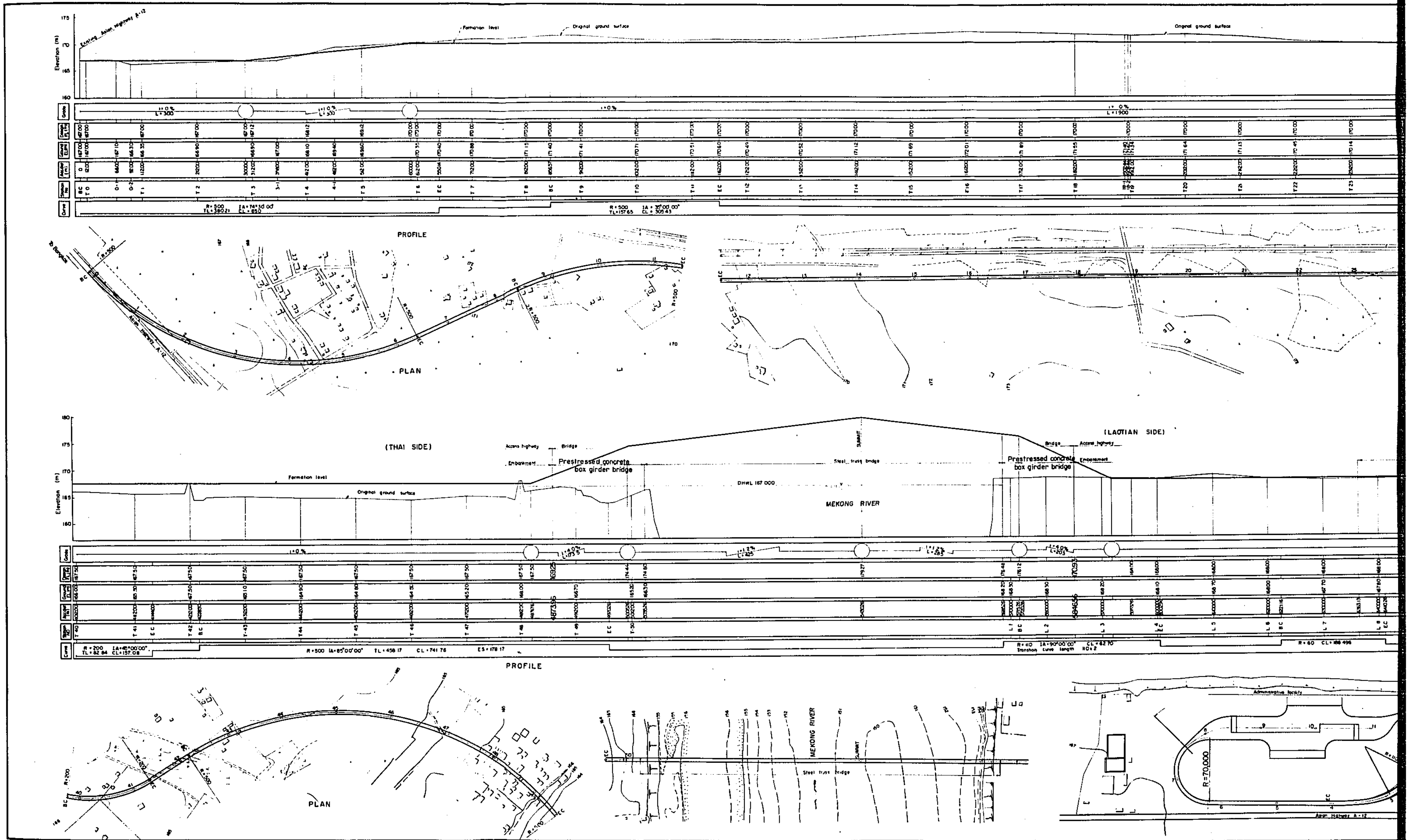
PROFILE



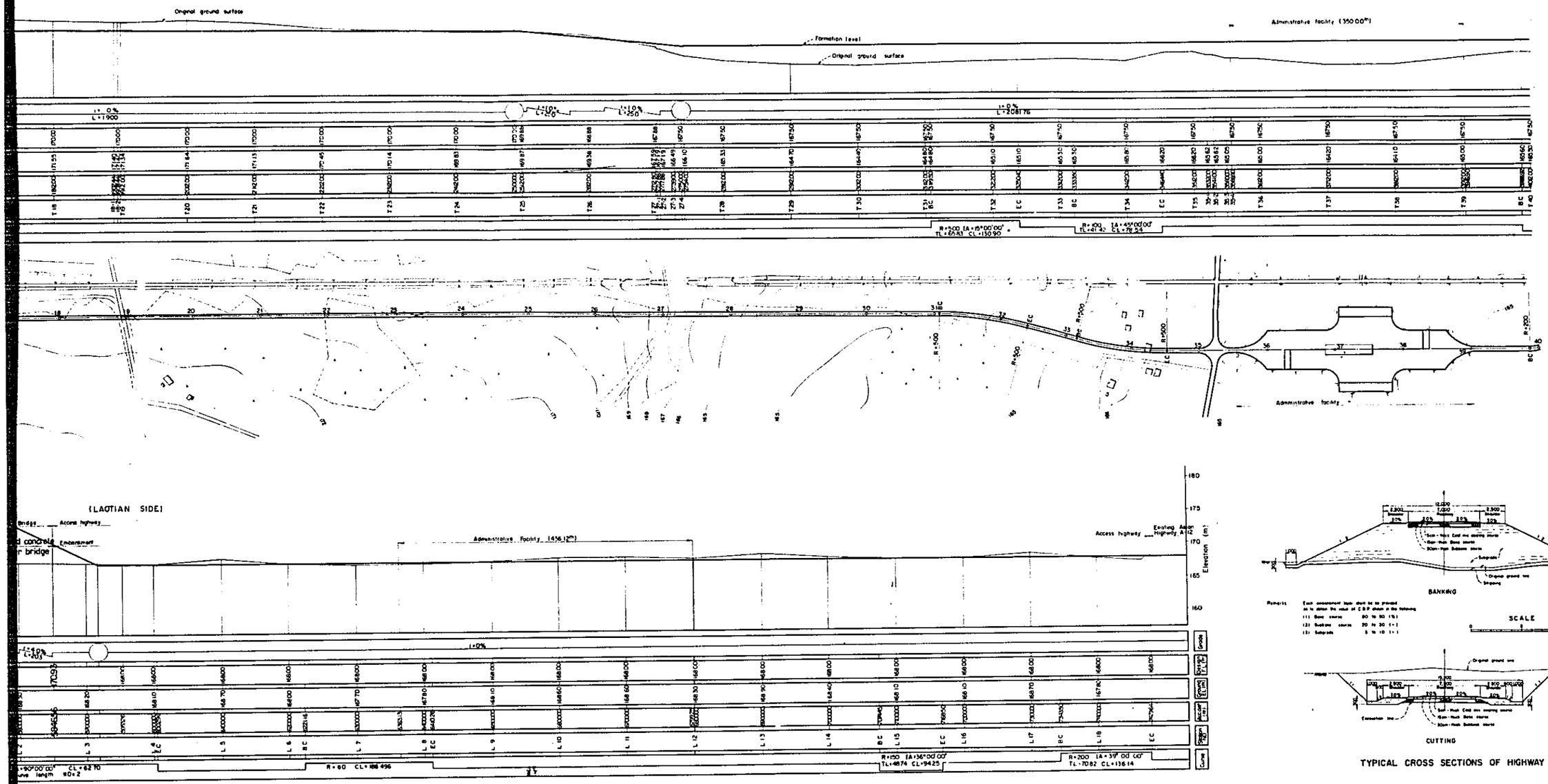
SECTION

0 5m

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO, JAPAN	
NONG KHAI / VIENTIANE BRIDGE PROJECT	
APPROACH VIADUCT	
NIPPON KOEI CO., LTD. TOKYO (CONSULTING ENGINEERS)	
DRAWN CHECKED SUBMITTED APPROVED	DATE PLATE 5



Existing Asian Highway A-12
Formation level
Original ground surface
Elevation (m)
Grade
PROFILE
PLAN
To Bangkok
(THAI SIDE)
(LAOTIAN SIDE)
Access highway
Bridge
Embankment
Prestressed concrete box girder bridge
Steel truss bridge
DHWL 167.000
MEKONG RIVER
SUMMIT
R=500 IA=35°00'00" TL=157.65 CL=305.43
R=200 IA=45°00'00" TL=82.84 CL=157.08
R=500 IA=85°00'00" TL=458.17 CL=741.76 ES=178.17
Administrative facility
R=70,000
Asian Highway A-12



TYPICAL CROSS SECTIONS OF HIGHWAY

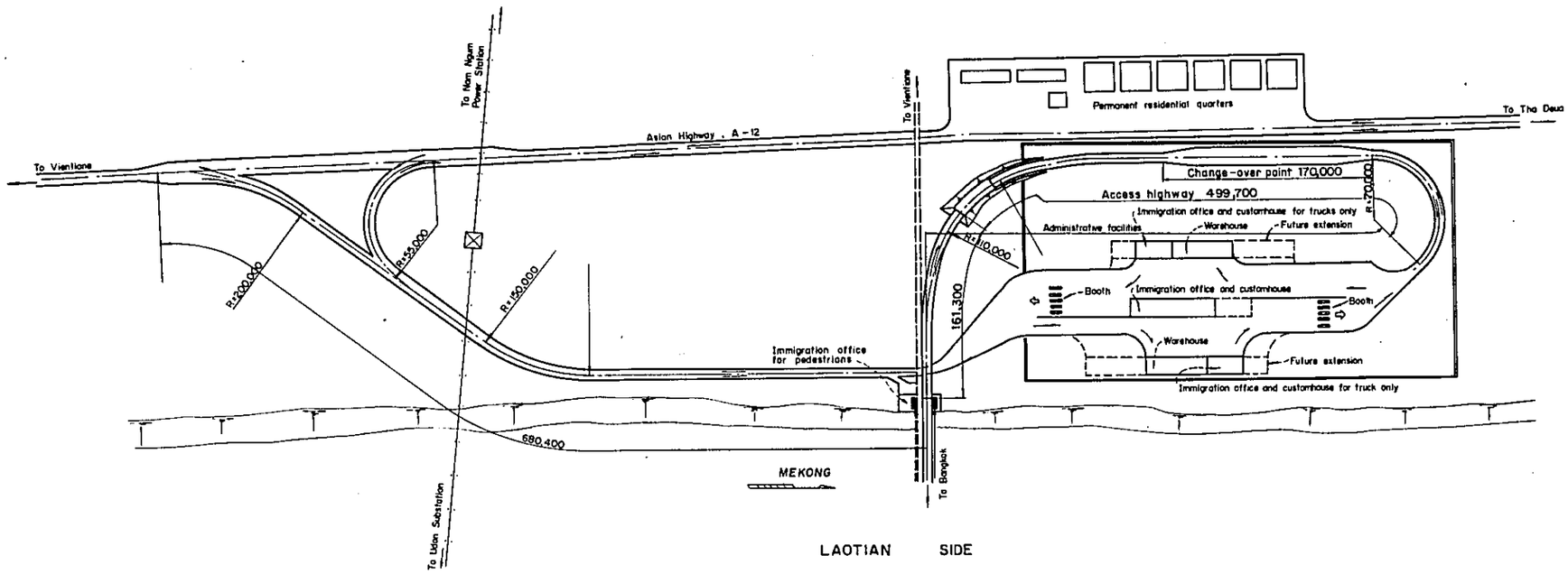
OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

NONG KHAI / VIENTIANE BRIDGE PROJECT

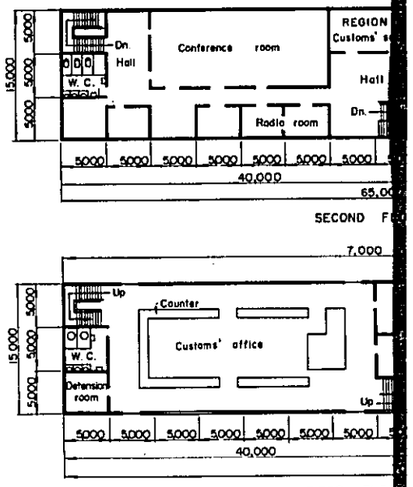
ACCESS HIGHWAY

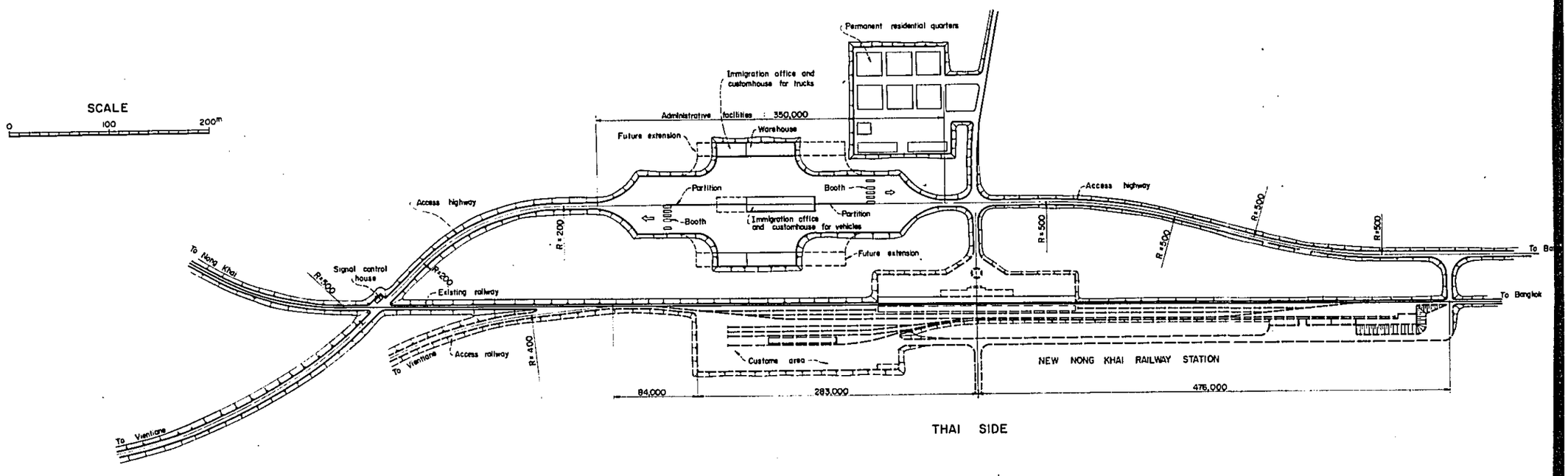
NIPPON KOEI CO., LTD. TOKYO
(CONSULTING ENGINEERS)

DRAWN	DATE
CHECKED	
SUBMITTED	
APPROVED	PLATE 6



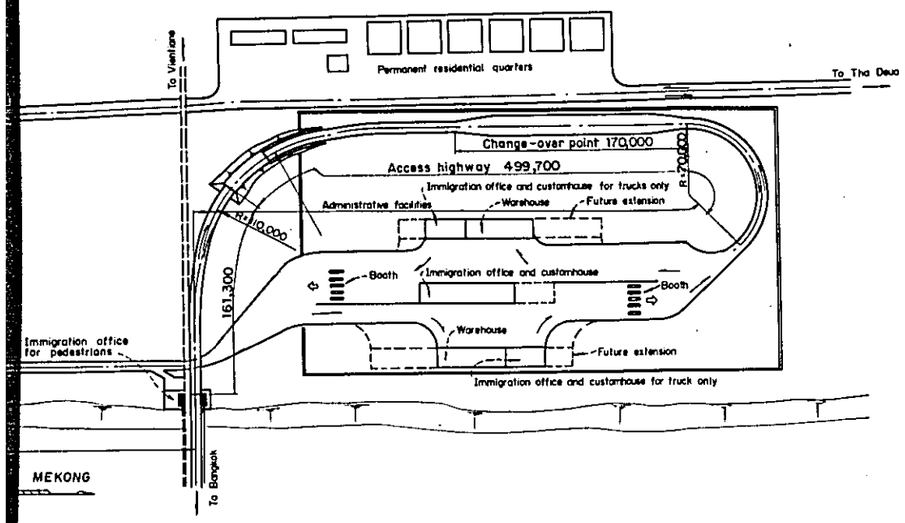
LAOTIAN SIDE





THAI SIDE

ADMINISTRATIVE FACILITIES



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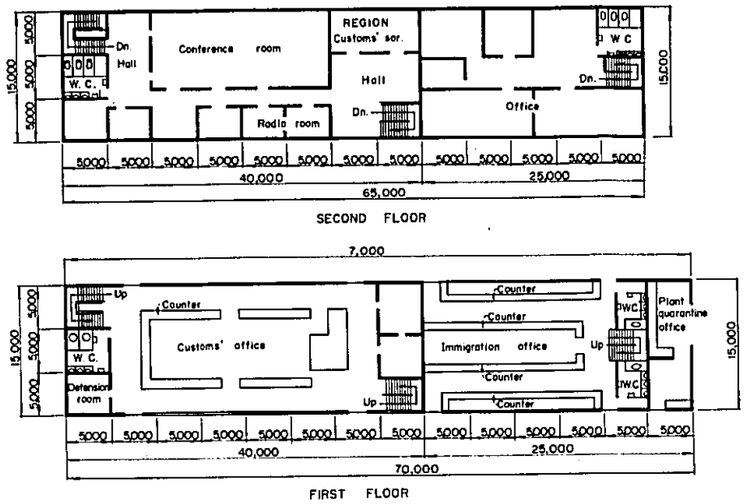
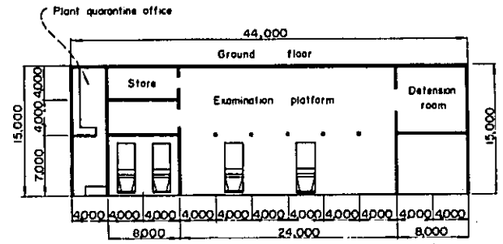


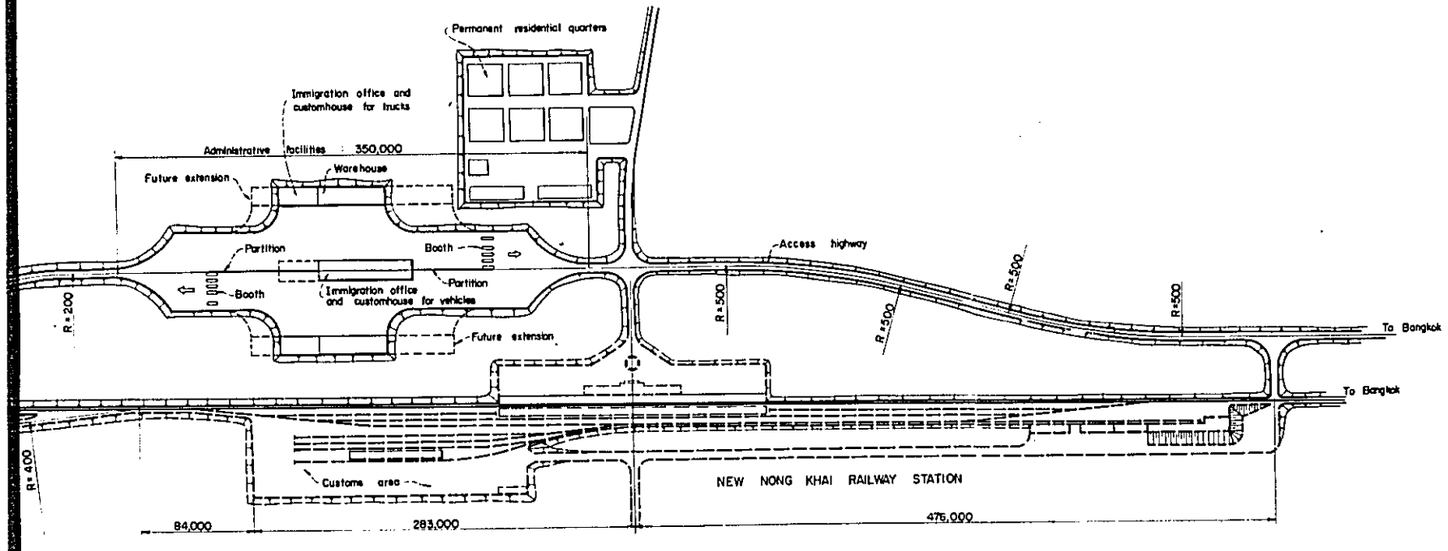
FOR VEHICLES EXCLUDING TRUCKS



FOR TRUCKS ONLY

SCALE
0 10 20m

IMMIGRATION OFFICE AND CUSTOMHOUSE



THAI SIDE

ADMINISTRATIVE FACILITIES

NOTE :

======= Future extension railway

OVERSEAS TECHNICAL COOPERATION AGENCY TOKYO - JAPAN	
NONG KHAI / VIENTIANE BRIDGE PROJECT	
ADMINISTRATIVE FACILTY	
NIPPON KOEI CO., LTD. TOKYO (CONSULTING ENGINEERS)	
DRAWN	DATE
CHECKED	
SUBMITTED	PLATE 7
APPROVED	

APPENDIX

COST ESTIMATE OF CONCRETE BRIDGE PLAN

APPENDIX

COST ESTIMATE OF CONCRETE BRIDGE PLAN

A.1 SUMMARY

This Appendix is prepared for use as reference by the Mekong Committee in further detailed investigation of this project, and contains the results of a tentative study made on the concrete bridge for the scaled-down plan. A suitable type of concrete bridge has been tentatively selected for the combined rail/highway bridge and the highway bridge, and the construction costs thereof have been estimated in this study. The bridge structures studied herein are confined only to the superstructure and piers of the main bridge. Type of pier foundation and other related highway facilities is not altered from the scaled-down plan stated in the main report, and construction period is also unchanged.

A prestressed-concrete box-girder was selected as the suitable type for concrete bridge at this site, taking into account the site topography and geology, the technical feasibility and the economy of construction. The construction cost of the bridge varies with length of pier spacing. Several cases of pier spacing were compared on the basis of the total construction cost of super-and substructures estimated by using the unit prices given in the main report. Among them the most economical pier spacing was 60 meters in the case of a rail/highway bridge, and 60 to 90 meters in the case of a highway bridge.

The total construction costs of the rail/highway bridge plan and the highway bridge plan were estimated respectively for the 60-meter pier spacing. It was US$16.3 million in the case of rail/highway bridge and US$14.8 million in the case of a highway bridge. In both cases, related highway facilities were included but the railway bridge girder and the railway facilities for former case were not included.

A.2 DESIGN

A.2.1 Design Criteria

Design criteria are the same as in the scaled-down plan dealt with

in the main report with the exception as stated below.

- Horizontal clearance of navigational requirement: no limitation (assumed)
- Design compressive strength of prestressed concrete (28-day age) : 350 kg/cm^2

A.2.2 Design Conception and Structural Features

In designing bridge structures, the following conceptions are taken into account.

- Where the river channel is very wide but relatively shallow and foundation rock lies below thin river deposit, a multispan girder bridge is most economical.
- Where the construction of scaffolding for superstructures is impracticable or risky, the construction method is inevitably limited to the cantilever method.
- Where the bridge span is expected to be as long as 50 meters or more and cantilever construction method is applied, the conventional reinforced-concrete girder is uneconomical. In such case, prestressed concrete girder is useful and economical.
- Where the bridge with long spans is to be constructed by cantilever method or it is continuous over piers, box girder is generally suitable because it has high torsional rigidity and girder body becomes slender.
- Where superstructure is longitudinally symmetrical on the supports, thin reinforced-concrete wall is economical as the bridge pier.

Based on these conceptions, a prestressed-concrete box-girder bridge was selected as the suitable type of bridge structure. However, the pier spacing is flexible, which will be determined by the cost analysis of super-and substructures. For this analysis, six cases with pier spacing of 50, 60, 70, 80, 90 and 100 meters were considered and their structures were provisionally designed as follows.

1) Superstructures

- Highway bridge

The bridge girder is fixed rigidly to each intermediate pier. But, hinged expansion joint is provided at each crown between piers in order to absorb complex stresses due to temperature change and to distribute horizontal force to each pier. Cross-section of the girder is selected from a single box shape having side cantilever decks in order to give high torsional rigidity. Widths of upper and lower flanges are 11.8 meters and 6.3 meters, respectively. Girder depth is gradually reduced from pier end towards each crown, for instance, from 3.4 meters to 1.5 meters in the case of 60-meter pier spacing or from 4.8 meters to 1.9 meters in the case of 90-meter pier spacing.

- Railway bridge

This design of a railway bridge is made only for use as reference in designing the substructures. Taking into account the railway extension in the future, the railway bridge girder is separated from the highway bridge girder though both are supported by the common piers. Single-box type is also used. However, the girder is designed as a continuous unit with no expansion joint over the entire length of the bridge, which is supported by movable shoes on each pier. Widths of upper and lower flanges are designed to be 5.7 meters and 2.7 meters repectively and the girder depth is gradually reduced from pier end towards crown: from 4.0 meters to 3.0 meters for 60-meter span or 6.0 meters to 4.0 meters for 90-meter span.

2) Substructure

The bridge pier is designed as a wall-type reinforced concrete structure with constant thickness of 2 meters since the superstructures are nearly symmetrical in the direction of bridge axis. Height of the pier is determined by vertical clearance of navigational requirement. Top of a pier has two levels stepwise so as to even both floor deck levels of highway and railway bridges. Width of pier in the case of rail/highway bridge is tapered towards foundation from 14.85 meters at the top in order to smoothly transmit the asymmetrical load on the pier to foundation.

But, in the case of highway bridge, such tapering is avoided and the width is 6.6 meters constantly.

Foundation structure to support superstructure and pier as well as live loads is temporarily designed as a circular caisson standing on shale of foundation rock. From the viewpoints of safety and economy of construction, pneumatic sinking caisson is applied for pier foundations in river channel while two abutment caissons are open caissons. The diameter of all the caissons is 12 meters in the case of rail/highway bridge and is 10 meters in the case of highway bridge.

A.3 COST ESTIMATE

Estimate of construction cost is made based on the unit prices described in the main report except the cost of the prestressed-concrete girder. As the unit construction cost of the prestressed concrete girder varies depending on the construction method and the construction period, they are assumed as follows:

Construction method: Dywidag cast-in-place cantilever method

Construction period: 2.5 years

Then, the unit cost of the prestressed concrete is estimated as follows:

	Cost per m^3 (US$ equivalent)
Concrete purchased from a domestic company (cement 400 kg/m^3) and forms:	90
Special movable scaffolds, cable crane and other related construction equipment and labors:	110
General expense:	40
Total	240

In order to select an economical pier spacing from the six cases mentioned in the section A.2, direct construction cost of the main bridge is estimated for each case. The results are illustrated graphically in Fig. A.1. From this figure, it is evident that the economical pier spacing is 60 meters in the case of rail/highway bridge and 60 to 90 meters, with no critical point, in the case of highway bridge.

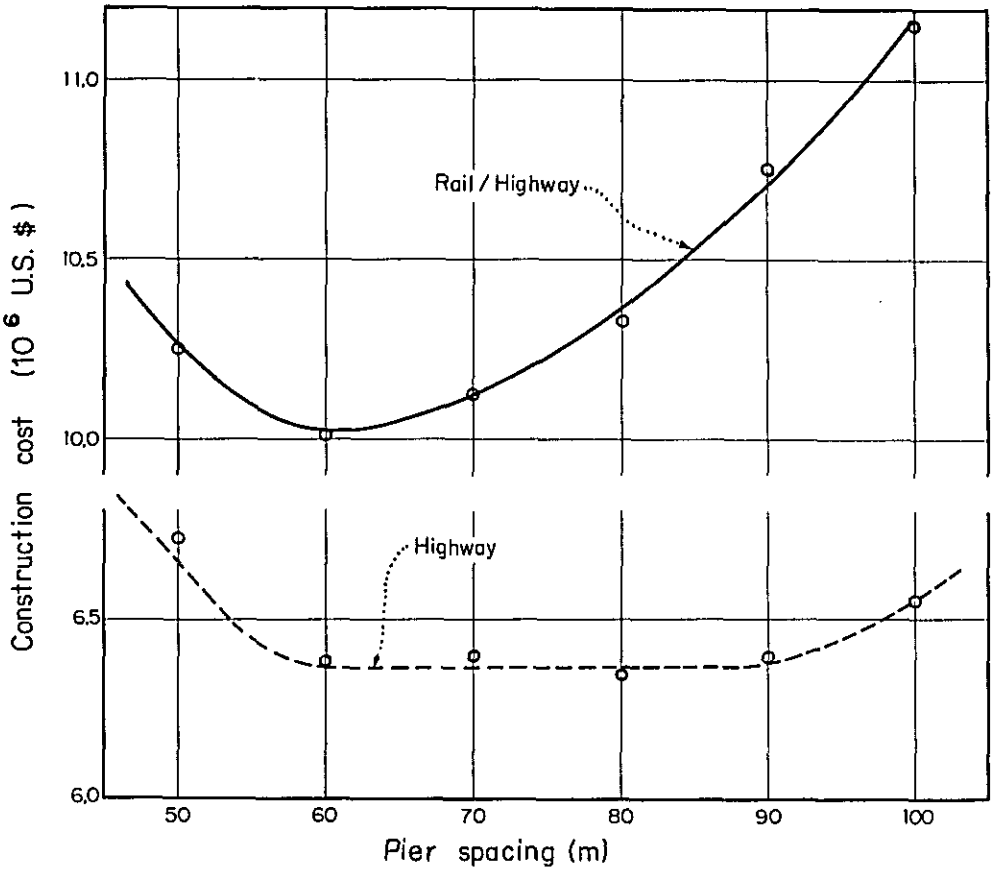
Therefore, the suitable bridge plan is considered to be an eleven 60-meter span, prestressed-concrete box-girder bridge for both the rail/highway bridge and the highway bridge. These bridges are tentatively designed as shown in PLATEs A.1 and A.2.

The total construction cost of the rial/highway bridge plan not including railway bridge-girder and railway facilities to be constructed in the future was estimated and tabulated in Tables A.1 and A.2. On the other hand, the total cost of the highway bridge plan can be easily obtained by estimating the cost reducible, with regard to the substructure, from that of the above rail/highway bridge plan. The total construction cost only of the highway bridge and related highway facilities under each bridge plan thus obtained is summarized as follows:

Construction Cost of Concrete Bridge Plan

Bridge plan	Foreign currency (US$)	Domestic currency (US$)	Total (US$)
1) Highway bridge in rail/highway bridge plan:	5,300,000	11,000,000	16,300,000
2) Highway bridge plan:	4,600,000	10,200,000	14,800,000

Fig. A.1 SPAN VS. COST OF CONCRETE BRIDGE



Pier spacing (m)	Number of pier	Construction cost (U.S. $)		
		Substructure	Superstructure	Total
50	14	4,700,000 (3,550,000)	5,550,000 (3,170,000)	10,250,000 (6,721,000)
60	12	4,300,000 (3,230,000)	5,710,000 (3,190,000)	10,010,000 (6,420,000)
70	11	4,200,000 (3,160,000)	5,920,000 (3,240,000)	10,120,000 (6,400,000)
80	10	4,060,000 (3,030,000)	6,270,000 (3,320,000)	10,330,000 (6,350,000)
90	9	3,890,000 (2,880,000)	6,870,000 (3,510,000)	10,760,000 (6,390,000)
100	8	3,640,000 (2,750,000)	7,510,000 (3,800,000)	11,150,000 (6,550,000)

Remarks :

(1) Cost of approach structures is not included

(2) The above construction costs do not include such indirect costs as expenses for engineering services, Government's administrative expenses and interests during construction

(3) The above construction cost in ( ) Is of highway

Table A.1 Construction Cost of Concrete Bridge Plan
(Summary for the rail/highway bridge)

	Work	Construction cost (US$)		
		Foreign currency	Domestic currency	Total
I.	GOVERNMENTS' PREPARATORY WORKS	269,000	810,000	1,079,000
	1. Construction facilities	269,000	225,000	494,000
	2. Land and rights		585,000	585,000
II.	MAIN CONSTRUCTION WORKS	3,439,000	7,698,000	11,137,000
	1. Bridges	3,439,000	4,709,000	8,148,000
	(a) Main prestressed concrete bridge			
	(i) Superstructure [1]	1,527,000	1,664,000	3,191,000
	(ii) Substructure	1,912,000	2,469,000	4,381,000
	(b) Approach viaduct		576,000	576,000
	2. Highway		1,219,000	1,219,000
	3. Administrative facilities		1,770,000	1,770,000
III.	GOVERNMENTS' ADMINISTRATIVE EXPENSE		730,000	730,000
IV.	ENGINEERING SERVICE	800,000	600,000	1,400,000
V.	CONTINGENCY AND RESERVE	492,000	1,292,000	1,784,000
VI.	INTEREST DURING CONSTRUCTION	300,000	600,000	900,000
	Total	5,300,000	11,000,000	16,300,000

[1] not including railway's girder

Table A.2 Itemized Construction Cost of Concrete Bridge Plan

(Rail/highway bridge)

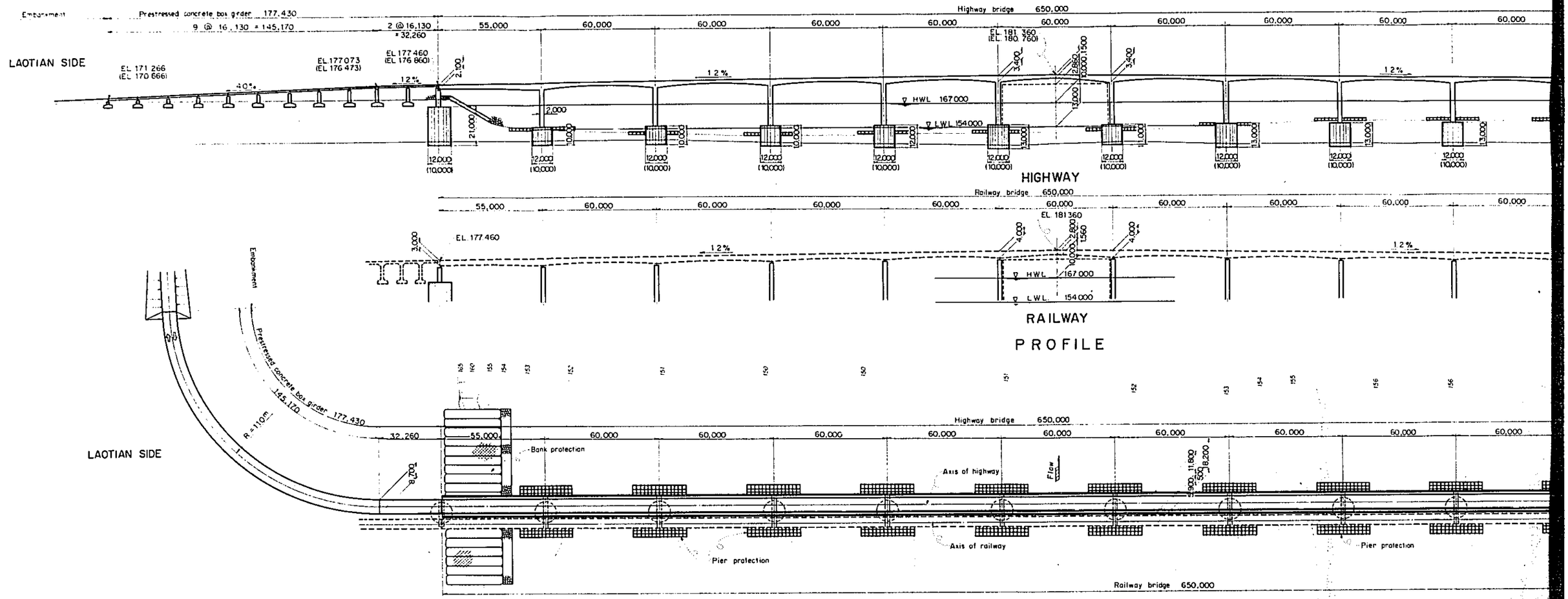
Item No.	Work	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Domestic Currency (US$) Unit Price	Domestic Currency (US$) Amount	Total (US$)	Remarks
I.	GOVERNMENTS' PREPARATORY WORKS				269,000		810,000	1,079,000	
1.	Construction facilities				269,000		225,000	494,000	
(a)	Temporary buildings	m^2	1,000			40	40,000	40,000	Offices and laboratory
(b)	Water supply system	L.S.					35,000	35,000	Pump and well
(c)	Electric power supply system								
c-1	22 kV distribution line	km	8			6,000	48,000	48,000	22 kV distr. line 8 km. long
c-2	Substation equipment	L.S.					40,000	40,000	One 1,000 kVA trans and others
c-3	Diesel power plants	L.S.					44,000	313,000	500 kW and 250 kW generators
(d)	Communication system	L.S.					18,000	18,000	One automatic telephone exchanger
2.	Land and rights	km^2	1.3			450,000	585,000	585,000	
II.	MAIN CONSTRUCTION WORKS				3,439,000		7,698,000	11,137,000	
1.	Bridges				3,439,000		4,709,000	8,148,000	650 m long
(a)	Main prestressed concrete bridge				3,439,000		4,133,000	7,572,000	
	(Superstructure of highway bridge)				(1,527,000)		(1,664,000)	(3,191,000)	
a-1	Concrete	m^3	5,850	80	468,000	160	936,000	1,404,000	Cement 400 kg/m^3
a-2	Reinforcement steels	ton	560	100	56,000	530	296,800	352,800	
a-3	Prestressed steels	ton	390	2,020	787,800	740	288,600	1,076,400	
a-4	Shoe and hinged bearings	No.	22	2,790	61,380	890	19,580	80,960	1.3 ton shoe and 1.0 ton hinge
a-5	Expansion joints	m	132	580	76,560	210	27,720	104,280	
a-6	Asphalt pavement	m^2	5,200	1	5,200	3	15,600	20,800	
a-7	Miscellaneous	L.S.			72,060		79,700	151,760	5 %
	(Substructure for rail/highway bridge)				(1,912,000)		(2,469,000)	(4,381,000)	
a-8	Excavation for piers, Class I	m^3	4,960	10	49,600	5	24,800	74,400	2 piers
	Class II	m^3	12,140	25	303,500	10	121,400	424,900	10 piers
a-9	Cutting edge steels	No.	12	510	6,120	3,540	42,480	48,600	4.5 ton edge
a-10	Concrete for pneumatic caissons	m^3	6,300	100	630,000	60	378,000	1,008,000	Cement 300 kg/m^3
a-11	Concrete for open caissons	m^3	2,000	80	160,000	60	120,000	280,000	Cement 300 kg/m^3
a-12	Concrete for piers	m^3	5,500	30	165,000	40	220,000	385,000	Cement 250 kg/m^3
a-13	Reinforcement steels	ton	1,360	100	136,000	530	720,800	856,800	
a-14	Steel sheetpiles	ton	750	390	292,500	360	270,000	562,500	75 kg/m sheetpiles
a-15	Structural steel for temporary bridge	ton	200	330	66,000	370	74,000	140,000	94 kg/m H-shape

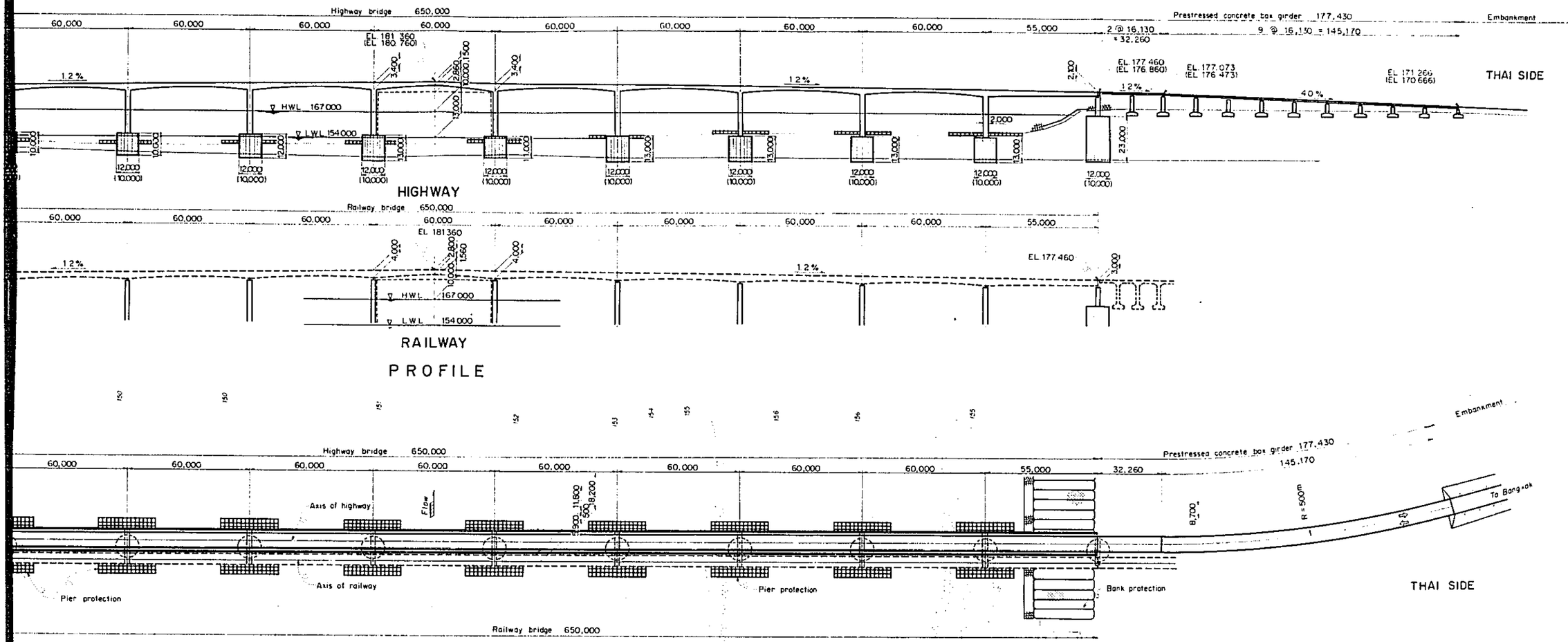
Table A.2 (Continued)

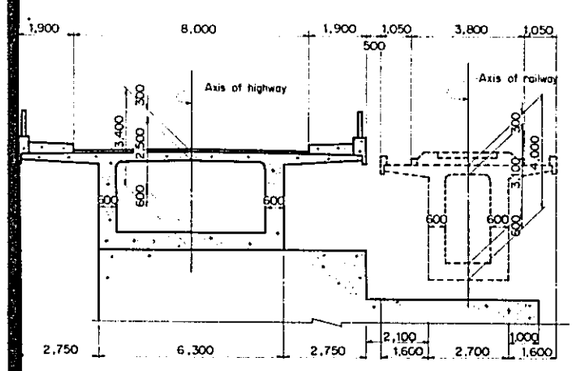
Item No.	Work	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Domestic Currency (US$) Unit Price	Domestic Currency (US$) Amount	Total (US$)	Remarks
	a-16 Wooden mattresses for pier protection	m^2	7,700	1	7,700	39	300,300	308,000	
	a-17 Gabione for bank protection	m^2	1,000	5	5,000	80	80,000	85,000	
	a-18 Miscellaneous	L.S.			90,580		117,220	207,800	5 %
(b)	Approach viaduct (Precast PC box girder bridge for highway)						576,000 (576,000)	576,000 (576,000)	2 x 177.43 m long
	b-1 Excavation, common, for piers	m^3	2,050			2	4,100	4,100	2 x 11 piers
	b-2 Concrete for superstructure	m^3	1,940			160	310,400	310,400	Cement 350 kg/m^3
	b-3 Concrete for substructure	m^3	950			70	66,500	66,500	Cement 250 kg/m^3
	b-4 Reinforcement steels	ton	90			630	56,700	56,700	
	b-5 Concrete piles for piers	No.	330			300	99,000	99,000	
	b-6 Asphalt pavement	m^2	2,840			4	11,360	11,360	
	b-7 Miscellaneous	L.S.					27,940	27,940	5 %
2.	Highway						1,219,000	1,219,000	5.6 km long
	2-1 Clearing and stripping	m^2	72,500			0.05	3,625	3,625	
	2-2 Excavation, common	m^3	26,500			1	26,500	26,500	
	2-3 Embankment	m^3	104,600			2	209,200	209,200	Including sodding
	2-4 Subbase course	m^3	47,900			3	143,700	143,700	
	2-5 Base course	m^3	38,900			3.5	136,150	136,150	
	2-6 Asphalt pavement	m^2	44,600			4	178,400	178,400	
	2-7 Concrete for box culverts	m^3	2,300			80	184,000	184,000	Cement 280 kg/m^3
	2-8 Reinforcement steels	ton	230			630	144,900	144,900	
	2-9 Guardrail	m	3,850			35	134,750	134,750	
	2-10 Miscellaneous	L.S.					57,775	57,775	5 %
3.	Administrative facilities						1,770,000	1,770,000	
	3-1 Clearing and stripping	m^3	50,300			0.1	5,030	5,030	
	3-2 Embankment	m^3	73,900			2	147,800	147,800	
	3-3 Subbase course	m^3	39,700			3	119,100	119,100	
	3-4 Base course	m^3	41,600			3.5	145,600	145,600	
	3-5 Asphalt pavement	m^2	39,650			4	158,600	158,600	
	3-6 Immigration offices and customhouse	m^2	6,500			120	780,000	780,000	
	3-7 Warehouses, booths and others	m^2	3,000			110	330,000	330,000	
	3-8 Miscellaneous	L.S.					83,870	83,870	5 %

Table A.2 (Continued)

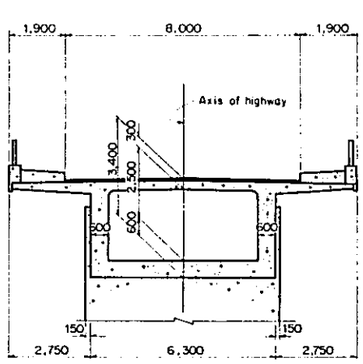
Item No.	Works	Unit	Quantity	Foreign Currency (US$) Unit Price	Foreign Currency (US$) Amount	Domestic Currency (US$) Unit Price	Domestic Currency (US$) Amount	Total (US$)	Remarks
III.	GOVERNMENTS' ADMINISTRATIVE EXPENSE	L.S.					730,000	730,000	6 % of (I) and (II)
IV.	ENGINEERING SERVICE	L.S.			800,000		600,000	1,400,000	5 % of (I) 15 % of (II)-1(a) 7 % of (II)-1(b) 7 % of (II)-2 5 % of (II)-3
V.	CONTINGENCY AND RESERVE	L.S.			492,000		1,292,000	1,784,000	15 % of (1) and (II)
VI.	INTEREST DURING CONSTRUCTION	L.S.			300,000		600,000	900,000	6 % of (I) to (V)
	Total				5,300,000		11,000,000	16,300,000	


Embankment
Prestressed concrete box girder 177.430
9 @ 16.130 = 145.170
2 @ 16.130 = 32.260
55.000
60.000
Highway bridge 650.000
LAOTIAN SIDE
EL 171 266
(EL 170 666)
EL 177 073
(EL 176 473)
EL 177 460
(EL 176 860)
40%
12%
2.000
21.000
10.000
12.000
(10.000)
HWL 167.000
LWL 154.000
EL 181 360
(EL 180 760)
3.400
2.860
1.500
13.000
11.000
HIGHWAY
Railway bridge 650.000
EL 181360
4.000
2.800
1.560
10.000
HWL 167.000
LWL 154.000
RAILWAY
PROFILE
Prestressed concrete box girder 177.430
155.170
R=110m
LAOTIAN SIDE
32.260
Bank protection
Axis of highway
Axis of railway
Flow
11.800
8.200
Pier protection
Railway bridge 650.000
PLAN
1.900
8.000
1.050
3.800
500
300
3.400
2.500
600
3.100
4.000
2.100
1.600
2.700
1.000
2.750
6.300
RAIL/HIGHWAY
150
HIGHWAY
TYPICAL CROSS SECTION





RAIL/HIGHWAY



HIGHWAY

TYPICAL CROSS SECTION

NOTE :
The above dimention in ( ) is highway bridge

0 50m
0 5m

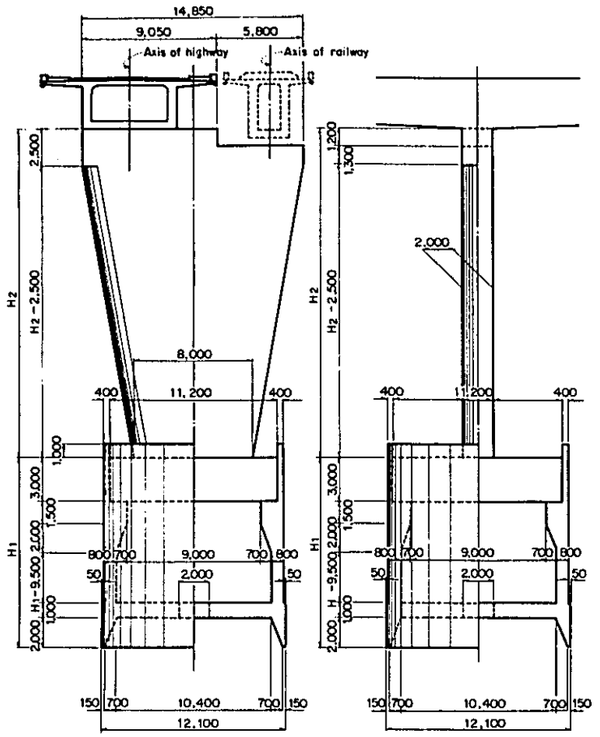
OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

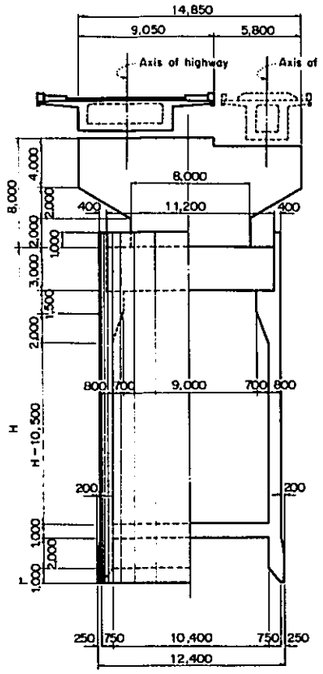
NONG KHAI/VIENTIANE BRIDGE PROJECT
CONCRETE BRIDGE PLAN
PLAN, PROFILE AND TYPICAL CROSS SECTIONS

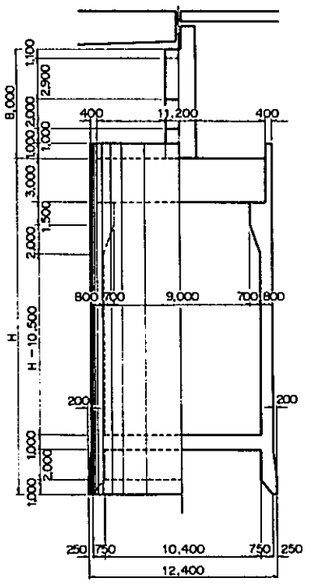
NIPPON KOEI CO., LTD. TOKYO
(CONSULTING ENGINEERS)

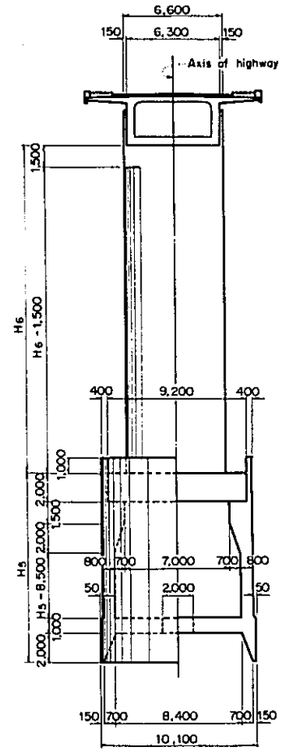
DRAWN
CHECKED
SUBMITTED
APPROVED
DATE

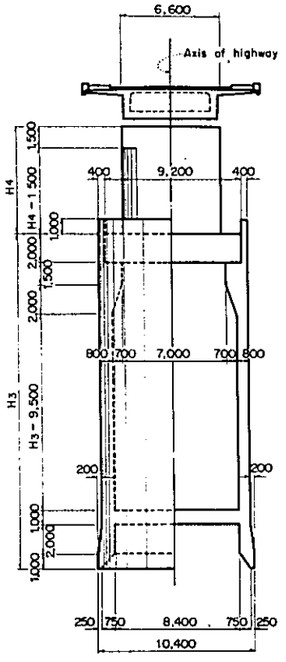
PLATE A.1

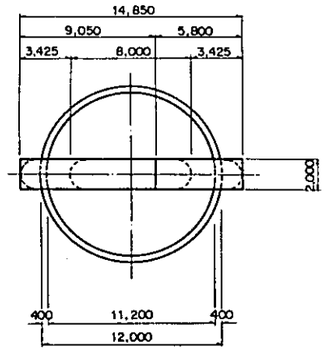


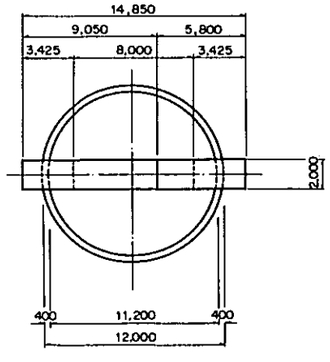


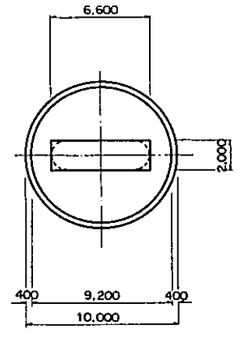


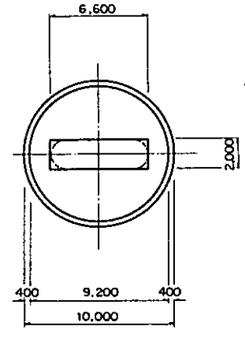












PIER AND PNEUMATIC CAISSON

PIER AND OPEN CAISSON

RAIL / HIGHWAY

PIER AND PNEUMATIC CAISSON PIER AND OPEN CAISSON

HIGHWAY

0 5 10m

Remarks :

Both open and pneumatic caisson are planned to be founded on the firm siltstone

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO, JAPAN

NONG KHAI / VIENTIANE BRIDGE PROJECT
CONCRETE BRIDG PLAN

BRIDGE SUBSTRUCTURE

NIPPON KOEI CO., LTD. TOKYO
(CONSULTING ENGINEERS)

DRAWN
CHECKED
SUBMITTED
APPROVED

DATE

PLATE A.2