7.2 Design of Intersection and Interchanges

7.2.1 Design Principle of Intersections

To determine the system and type of intersection, the following technical and economical conditions have been considered.

- At-grade type intersection such as channel lined or not channels lined T-shaped intersections should not be provided from the traffic safety viewpoint. It is recommended to provide road crossing structures such as box culverts in the approach road sections where the existing minor roads and waterways are to be connected through service roads.

- An interchange is a useful and an adaptable solution for many intersection problems, but because of the high initial cost, its use to eliminate existing traffic congestion/ bottleneck or to correct existing hazardous conditions should be limited to those cases where the required expenditure can be justified. In this Project, the four interchanges were decided having given consideration to future full control access, to connection with heavily traveled routes such as the National Highway No.1, to avoiding serious accidents and reducing the road-user costs such items as fuel, tires, oil, repair, etc., and to traffic volumes that were in excess of the capacity of at-grade intersections.

7.2.2 Selection of Intersection and Interchange Type

In addition to these considerations, the site investigation and discussions were conducted with the People's Committee of both Vinh Long and Can Tho Provinces. The types of interchange were selected mainly according to geometrical conditions. The following four interchange systems were selected based on the comparison study as shown in Figure 7.3 to 7.7.

(1) Interchange (Project Route and National Highway No.1 Vinh Long)

- Recommended type : Semi Y-type with half interchange system

(2) Interchange (Project Route and National Highway No.54)

- Recommended type : Diamond type with full interchange system

(3) Interchange (Project Route and National Highway No.91 & 91B)

- Recommended type : Diamond type with full interchange system

(4) Intersection (Project Route and National Highway No.1 Can Tho)

- Recommended type : At grade Intersection

7.2.3 Alignment Design at the Beginning Point (Vinh Long Side)

For the horizontal alignment design at beginning point (Vinh Long side), the following geometrical conditions were considered.

- The design speed of the Project is 60km/hr, however, 40km/hr was applied for the alignment design of the interchange at the beginning point, with considering the connection with Expressway from Ho Chi Minh City to Can Tho in the future scheme.

- To connect with the on and off roads, i.e. the shifted roads in the two direction (to Vinh Long and to Can Tho) of the existing NH No.1. At this connection, a geometrical horizontal radius of 2,000m was designed to fulfill the geometrical requirements as interchange system (not less than 450m to the design speed of 60km/hr.).

- The main route crossing over the existing NH No.1 and the Tra Da River was designed with the function of alignment separation with the design speed of 60km/hr to economize the land acquisition cost and to avoid the location of the temples.

- The geometrical horizontal radius of this main route is 300m. The minimum radius with the design speed of 60km/hr is not less than 250m.

7.2.4 Further Study on the Interchange Types (NH No. 54 and NH No. 91B)

The types of interchange for both connections with NH No.54 and NH No.91B were compared as shown in Figure 7.8 and 7.9, respectively. The comparison studies were summarized in Figure 7.8 and Figure 7.9, respectively, and Table 7.8.

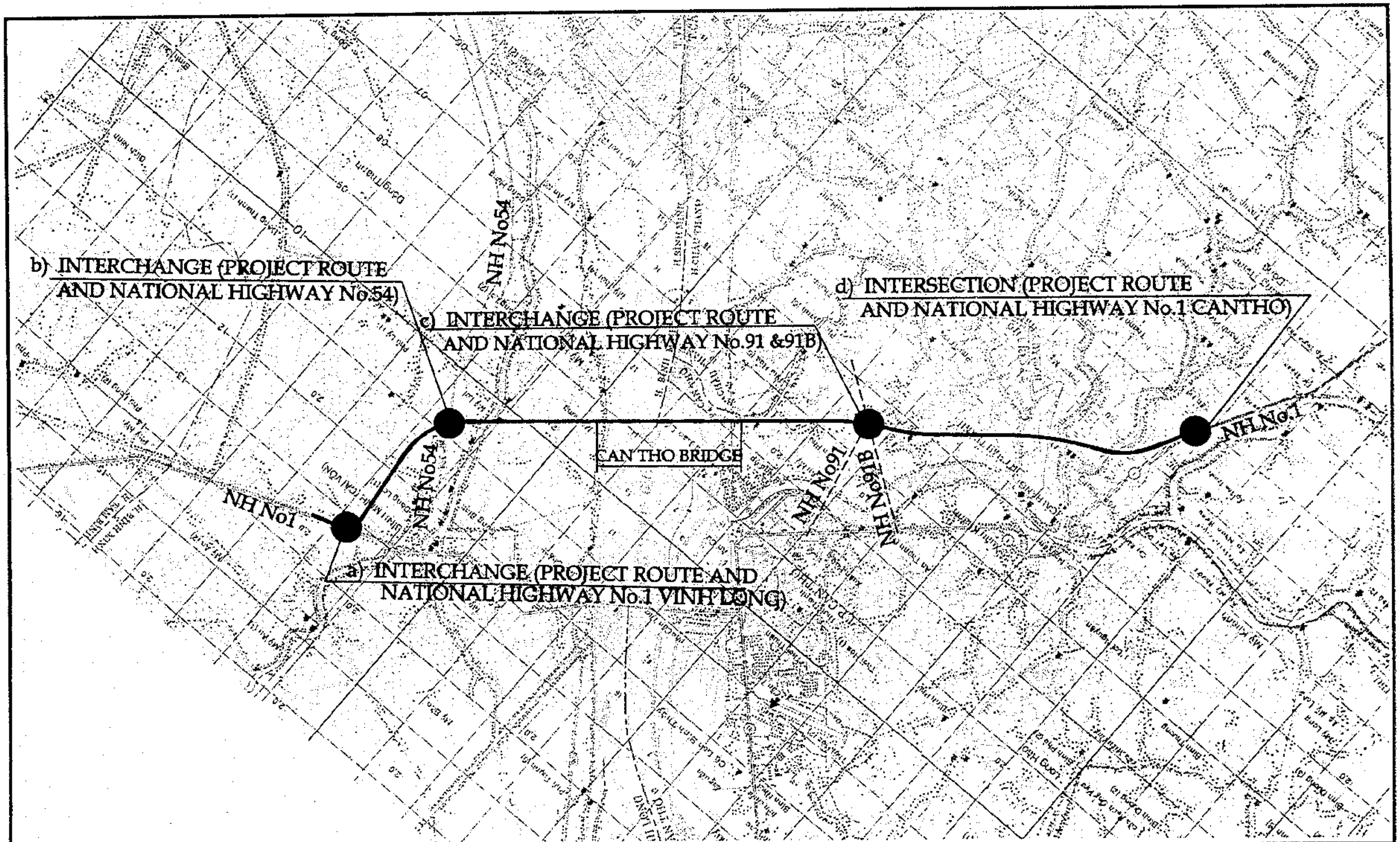
Table 7.8 Comparison Study of the Type of Interchange
(Both of NH No.54 and NH No.91B)

Case	Comparison Study
Case -1	<Advantage> - Smaller area of land acquisition - Shorter length of rampway <Disadvantage> - Necessity of the longer and wider bridge structure that cause the increase of the construction and land acquisition costs - Necessity of the higher embankment (average, 4.2m) of the Project road that will affect worse for the drainage for the inundated area around the whole road embankment - Unsuitable and unsafe geometry of the Project road due to the up and down vertical alignment - Cause of the unsuitable traffic due to the short interval of the intersections
Case -2	<Advantage> - Smaller influence for the drainage for the inundated area around the whole road embankment because of the lower embankment height of Project road - Economizing of the construction cost due to the smaller bridge area - Smooth traffic due to sufficient interval of the intersections <Disadvantage> - Image of detour given to the drivers due to the longer rampway length - Inconvenience for the land use around the interchange due to the closed and limited area by the rampway structures

Note: General figures of the Cases were shown in Figure 7.8 and Figure 7.9.

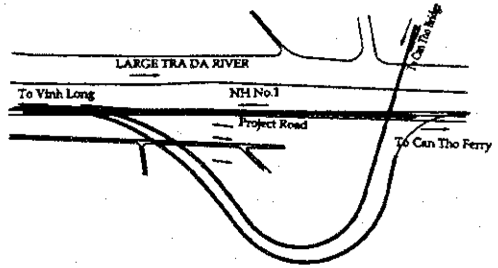
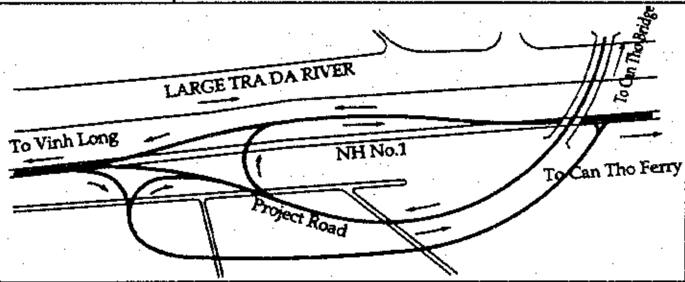
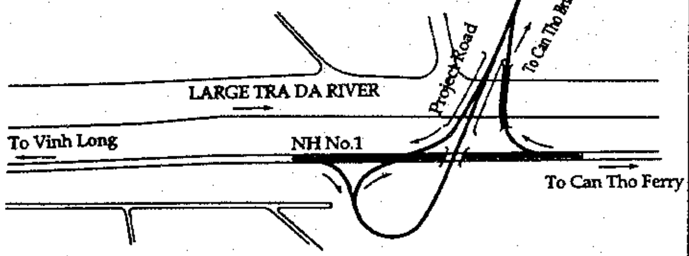
Consequently, "Case -2" (the type of interchange with that the project road passing under the crossing roads) was selected for the both of interchanges, because of the following reasons:

- Minimization of the inundation problems around the embankment of the Project road
- Minimization of the cost of land acquisition and construction
- Suitable interval of the intersections that serves the smooth and comfortable traffic



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 7.3 Location Map of Route, Intersection and Interchanges JAPAN INTERNATIONAL COOPERATION AGENCY

COMPARISON OF INTERCHANGE TYPE AT THE BEGINNING POINT (NH NO.1,Vinh Long)

	Area of Interchange	Traffic System	Construction Cost Ratio	Remarks
CASE-1 SEMI Y TYPE WITH HALF INTERCHANGE SYSTEM				
	Middle (7.0ha)	- Larger radius for the connecting ways. - Larger trafficable volume for the main ways for the Can Tho Bridge. - Traffic between Cai-Von town and Can Tho Bridge use the inter-change of NH No.54.	1.14	Recommended
CASE-2 SEMI Y TYPE WITH FULL INTERCHANGE SYSTEM				
	Larger (13.5ha)	- Larger radius for the connecting ways. - Larger trafficable volume for the main ways for the Can Tho Bridge. - This system needs intersection in the NH 1 on the side of Cai Von side. - This system needs much more resident resettlement.	1.40	
CASE-3 TRUMPET TYPE WITH FULL INTERCHANGE SYSTEM				
	Smaller (5.0ha)	- Smaller radius for the connecting ways. - Smaller trafficable volume for the main ways for the Can Tho Bridge. - This system needs 3 bridges in the interchange.	1.00	

THE DETAILED DESIGN OF
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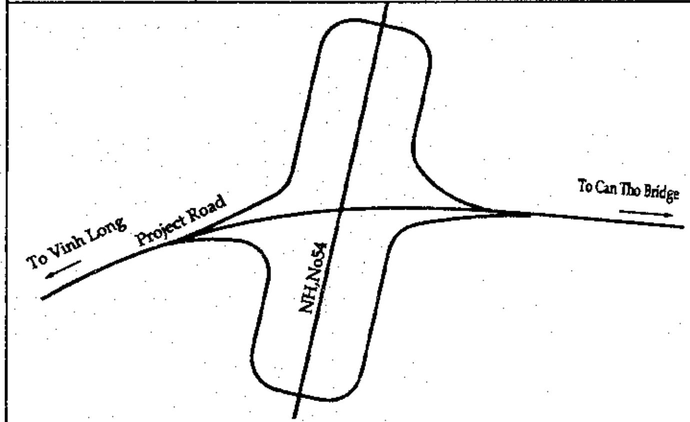
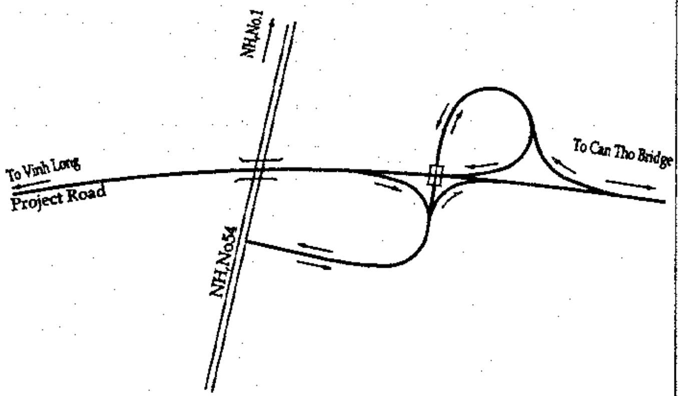
Figure 7.4 Comparison of Interchange Type at the Begining Point (NH No. 1 Vinh Long)

JAPAN INTERNATIONAL COOPERATION AGENCY

COMPARISON OF INTERCHANGE TYPE (NH No.54)

	Area of Interchange	Traffic system	Construction Cost Ratio	Remarks
CASE-1 DIAMOND TYPE WITH FULL INTERCHANGE SYSTEM				
	Larger (16.0ha)	- Larger radius for the ramp ways. - Outflow inflow of the traffic is smooth.	1.00	Recommended.
CASE-2 TRUMPET TYPE WITH FULL INTERCHANGE SYSTEM				
	Smaller (7.0ha)	- Smaller radius for the ramp ways. - Larger trafficable volume of the interchange.	1.10	

THE DETAILED DESIGN OF
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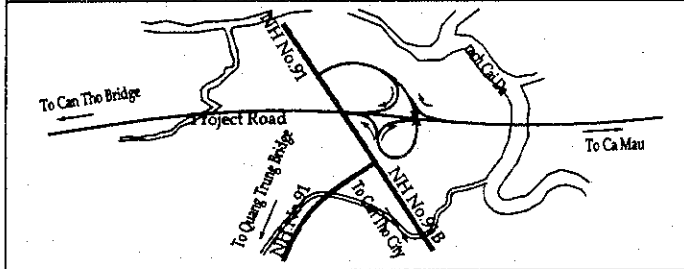
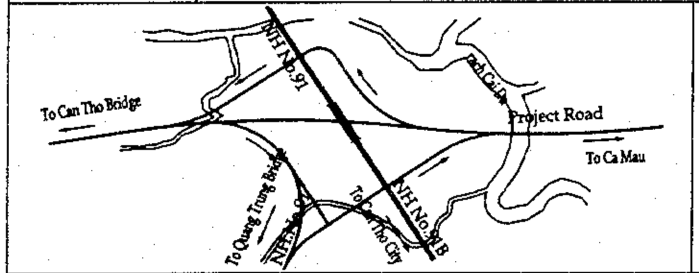
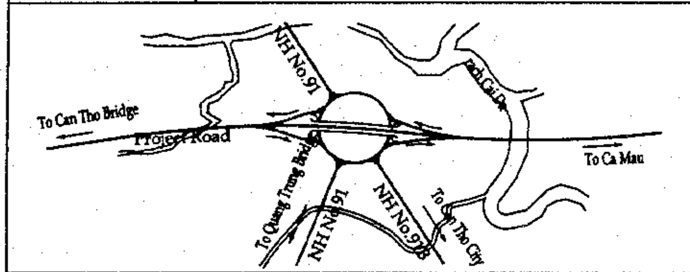
Figure 7.5 Comparison of Interchange Type (NH No. 54)

JAPAN INTERNATIONAL COOPERATION AGENCY

COMPARISON OF INTERCHANGE TYPE (NH No.91,No.91B)

	Area of Interchange	Traffic system	Construction Cost Ratio	Remarks
CASE-1 TRUMPET TYPE WITH FULL INTERCHANGE SYSTEM				
	Smaller (6.7ha)	- Larger traffic volume for interchange.	1.05	Recommended by the People's committee of Can Tho Province. Land acquisition only to be recommended.
CASE-2 DIAMOND TYPE WITH FULL INTERCHANGE SYSTEM				
	Larger (12.3ha)	- Medium traffic volume for interchange.	1.00	Recommended.
CASE-3 ROTARY TYPE WITH FULL INTERCHANGE SYSTEM				
	Middle (9.7ha)	- Smaller traffic volume for interchange. - Traffic flow intertwines and the safety inferior.	1.60	

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THE CAN THO BRIDGE CONSTRUCTION
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Figure 7.6 Comparison of Interchange Type
(NH No. 91, No. 91B)

JAPAN INTERNATIONAL COOPERATION AGENCY

COMPARISON OF INTERCHANGE TYPE AT END POINT (NH No.1,CAN THO)

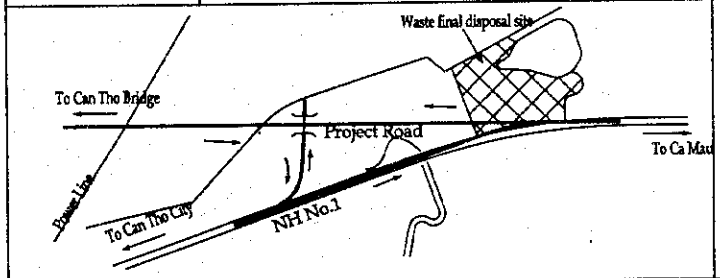
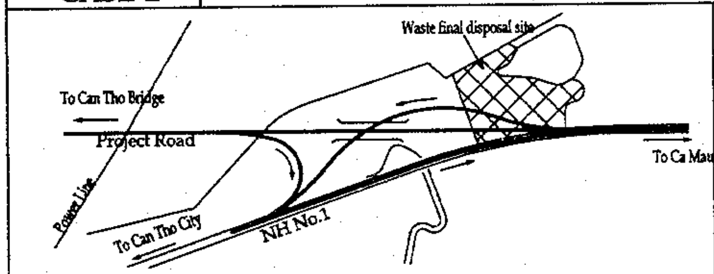
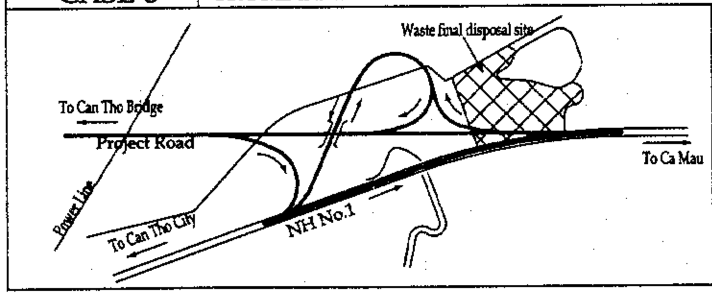
	Area of interchange	Traffic System	Construction Cost Ratio	Remarks
CASE-1 AT-GRADE INTERSECTION				
	Smaller (5.2ha)	- Full accessibility. - Smaller trafficable volume of the interchange.	1.00	Recommended, recognized by people's committee of the Can Tho province
CASE-2 SEMI Y TYPE WITH THREE QUARTER INTERCHANGE SYSTEM				
	Larger (7.8ha)	- Larger trafficable volume for the main ways for the Can Tho Bridge. - Traffic between Cai-Rang town to Can Tho Bridge use the interchange of NH No.91.	1.50	
CASE-3 TRUMPET TYPE WITH FULL INTERCHANGE SYSTEM				
	Larger (7.8ha)	- Full accessibility. - Larger trafficable volume of the interchange.	1.40	

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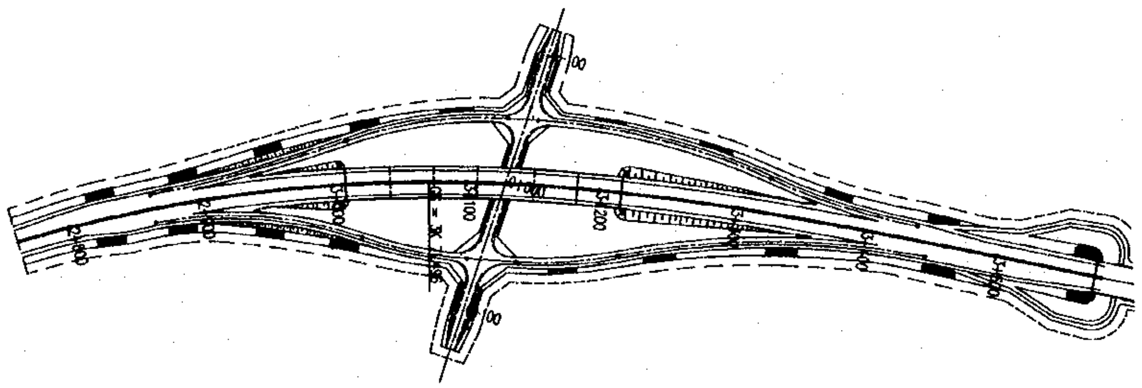
Figure 7.7 Comparison of Interchange Type at End Point (NH No. 1, Can Tho)

JAPAN INTERNATIONAL COOPERATION AGENCY

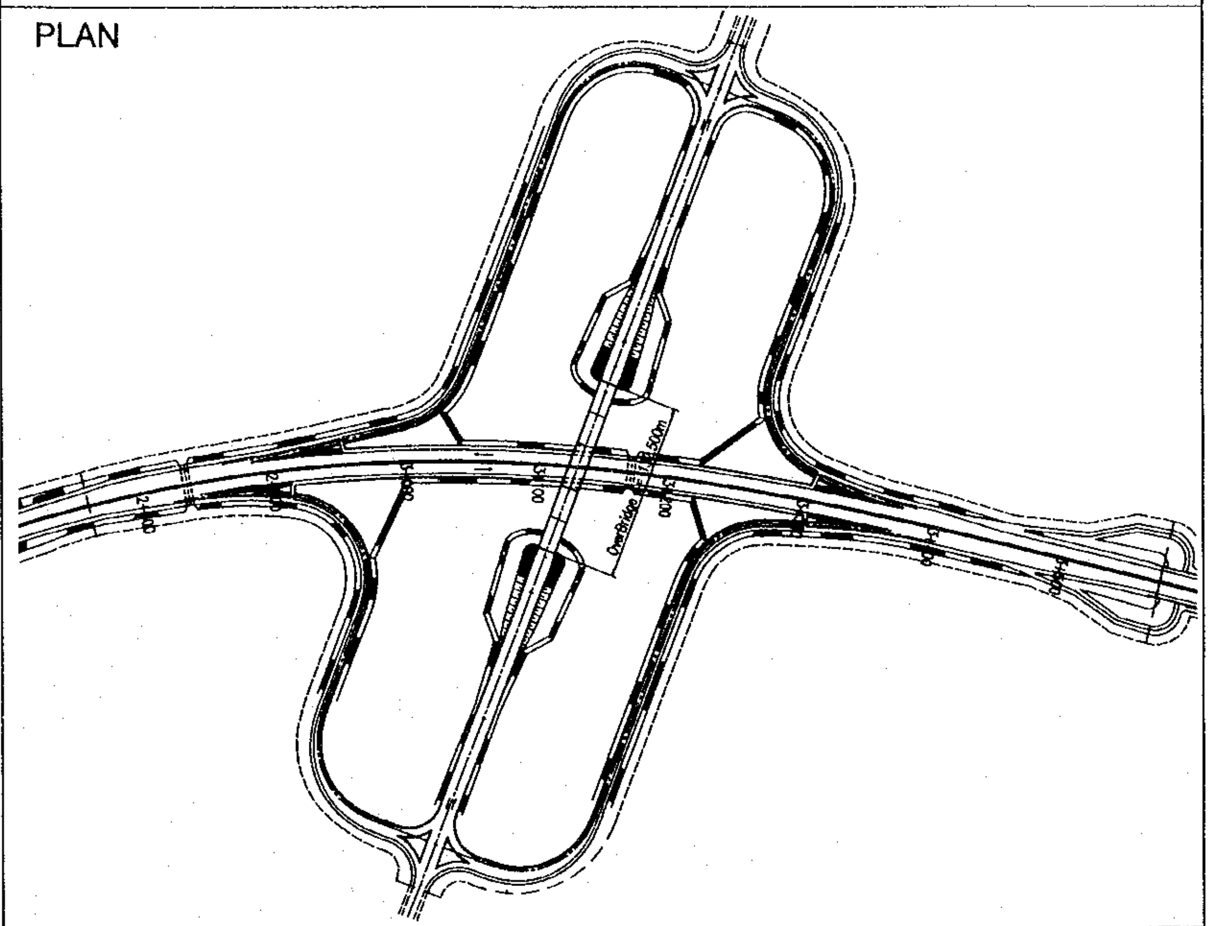
CASE-1 THE PROJECT ROAD OVERPASS NH NO.54

PLAN

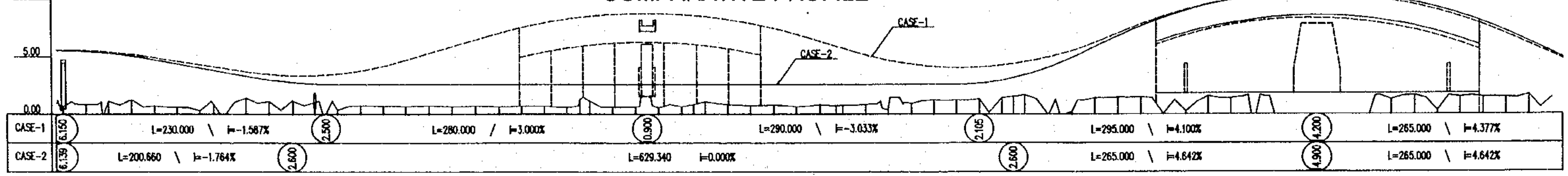


CASE-2 THE PROJECT ROAD UNDERPASS NH NO.54

PLAN



COMPARATIVE PROFILE



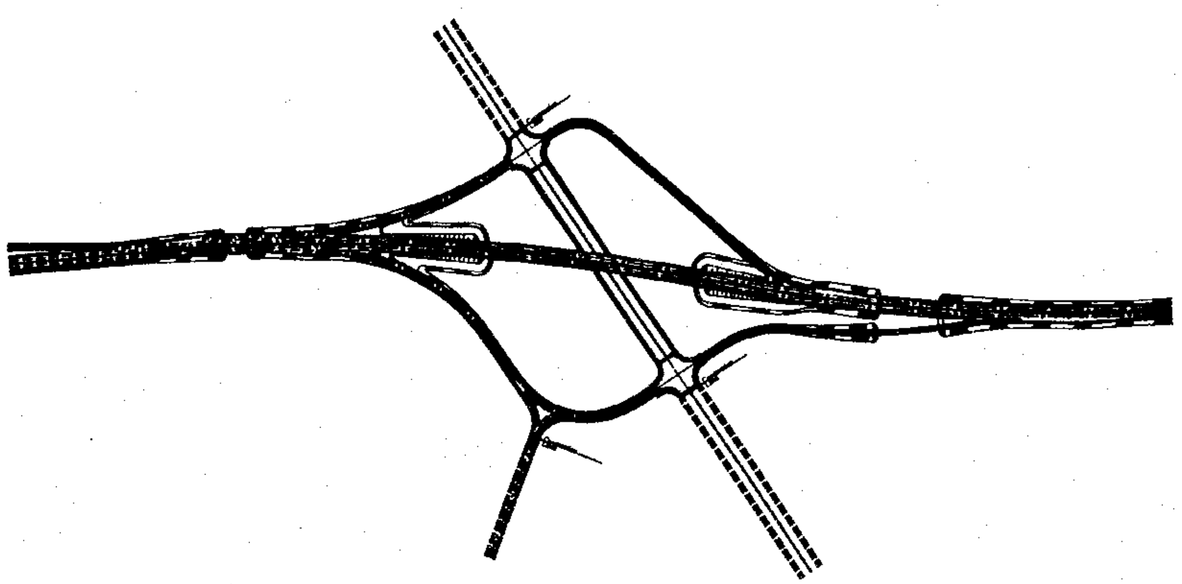
COMPARATIVE ITEM		CASE-1	CASE-2
TOTAL COST (THOUSAND US$)		8647	4132
CONSTRUCTION COST (")		8499	3752
LAND ACQUISITION COST (")		148	380
LAND ACQUISITION AREA (m²)		74000	190000
LENGTH OF RAMPWAY (m)		825	1654
MINIMUM RADIUS OF RAMPWAY(m)		300	60
AREA OF BRIDGE SURFACE (m²)		5090	1650
MAXIMUM GRADIENT (%)		4.1	4.6
MINIMUM VERTICAL CURVE RADIUS (m)	CREST	4010	4000
	SUG	3050	2150
AVERAGE EMBANKMENT HEIGHT(m)		4.2	2.2

Note: Comparative Section is CHA. 2K760 - CHA. 3K575.

PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGENCY	JICA STUDY TEAM		PREPARED BY	CHECKED BY	APPROVED BY	DRAWING TITLE	DWG NO.
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF VIET NAM MINISTRY OF TRANSPORT (MOT) MY THUAN PROJECT MANAGEMENT UNIT	NIPPON KOEI CO.,LTD.	NAME				Figure 7.8 Comparison of Interchange Style (NH No. 54)	
				SIGNATURE					
				DATE					

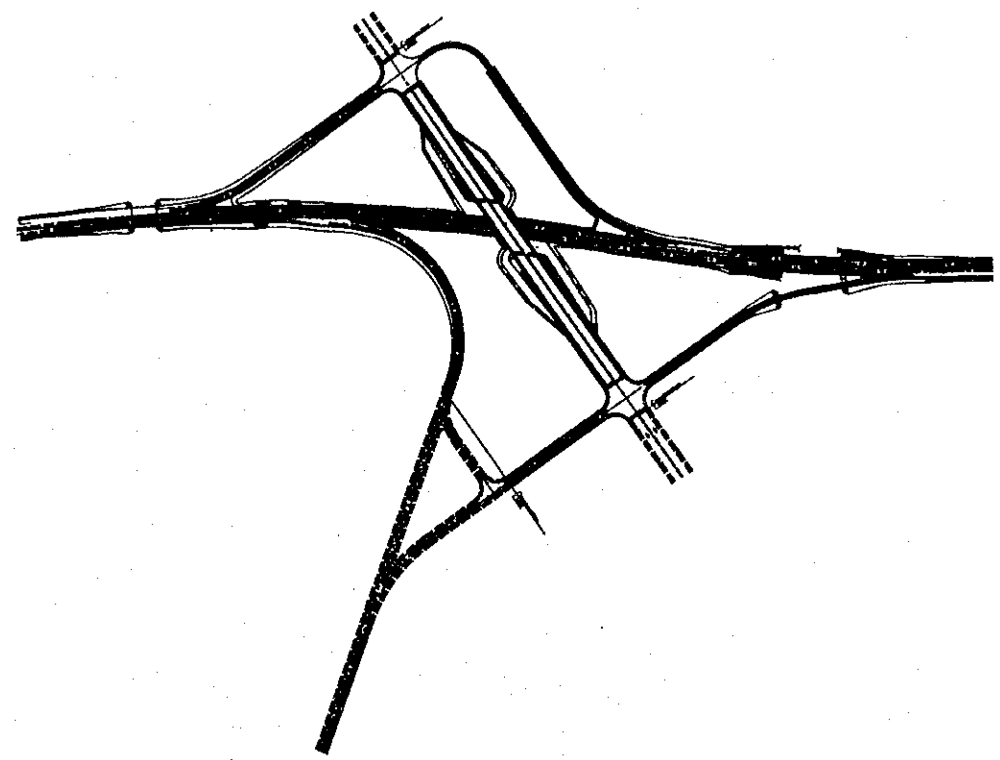
CASE-1 THE PROJECT ROAD OVERPASS NH NO.91B

PLAN

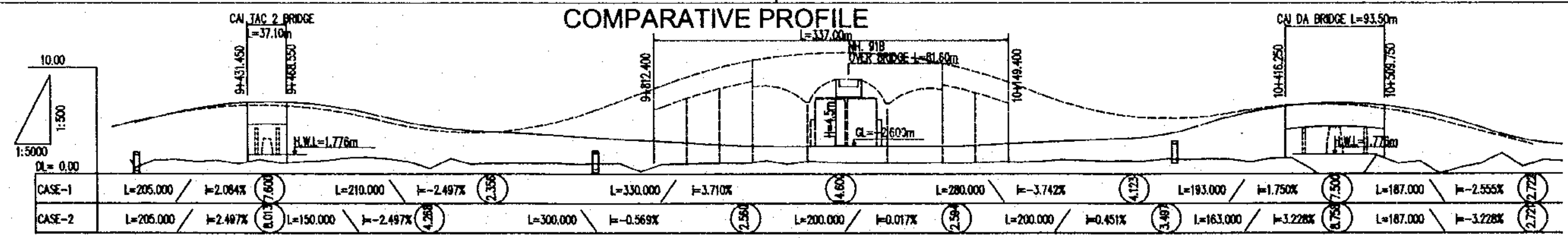


CASE-2 THE PROJECT ROAD UNDERPASS NH NO.91B

PLAN



COMPARATIVE PROFILE



COMPARATIVE ITEM		CASE-1	CASE-2
TOTAL COST (THOUSAND US$)		14594	5919
CONSTRUCTION COST (")		14198	5418
LAND ACQUISITION COST (")		396	501
LAND ACQUISITION AREA (ha)		198000	250700
LENGTH OF RAMPWAY (m)		1620	2150
MINIMUM RADIUS OF RAMPWAY(m)		60	60
AREA OF BRIDGE SURFACE (m^2)		8122	2448
MAXIMUM GRADIENT (%)		3.74	3.23
MINIMUM VERTICAL CURVE RADIUS (m)	CREST	4180	4000
	SUG	3220	2160
AVERAGE EMBANKMENT HEIGHT(m)		4.5	2.7

Note: Comparative Section is CHA. 9K470 – CHA. 10K410.

PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGENCY	JICA STUDY TEAM		PREPARED BY	CHECKED BY	APPROVED BY	DRAWING TITLE	DWG NO.
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF VIET NAM MINISTRY OF TRANSPORT (MOT) MY THUAN PROJECT MANAGEMENT UNIT	NIPPON KOEI CO.,LTD.	NAME				Figure 7.9 Comparison of Interchange Type (NH No. 91B)	
				SIGNATURE					
				DATE					

7.3 Design of Main Bridge (Cable Stayed Bridge) and Approach Span Bridges

7.3.1 Design Condition

(1) General

a) Standard and Specifications

Table 7.9 Standard and Specifications

Name of Standards, Specification, or Guideline
- Design Criteria for Bridge Design for The Can Tho Bridge Construction Project (1999)
- AASHTO, LRFD specifications for Bridge Design (1998)
- Design Specification for Highway Bridge and Culvert (22TCN18-79)
- Japanese Highway and Bridge Standard

b) Geometry of Main and Approach Span Bridges

Table 7.10 Geometry of Main & Approach Span Bridges

i) Categories of Main & Approach Span Bridges

Main Bridge	Hybrid (PC & Steel) Cable Stayed Bridge
Approach Viaduct	Part of Approach Span Bridges, PC Composite I Girder
Substream Bridge	Part of Approach Span Bridges, Continuous PC Box Girder

ii) Geometry of Main Bridge (Hybrid Cable Stayed Bridge)

- Type of Superstructure

Type of Bridge	7-Spans continuous Hybrid (PC & Steel) Cable Stayed Bridge
Span Arrangement	2@70+130+550+130+2@70 = 1,090m
Type of Girder	Pre-Cast Segmental PC Box Girder & Steel Box Girder
Type of Pylon	Reinforced Concrete Pylon
Foundation	Cast in Place Concrete Pile, Dia. 1.50m, 2.00m, and 3.00m

- Type of Substructures

Number of Pier	Type of Substructure	Type of Foundation	Condition of Bearing Shoe
P12, P13, P14	2-Column Pier	Cast in Place Concrete Pile (Dia. 1,500)	Elastometric
Northern Pylon	A - Type Pylon	Cast in Place Concrete Pile (Dia. 3,000)	Elastometric
Southern Pylon	A - Type Pylon	Cast in Place Concrete Pile (Dia. 3,000)	Elastometric
P15, P16, P17	2-Column Pier	Cast in Place Concrete Pile (Dia. 2,000)	Elastometric

iii) Geometry of Approach Span Bridge (Vinh Long side, A1 ~ P12)	
Type of Superstructure	3-spans Continuous Composite PC I Girder
Span Arrangement	12@40m = 480m
Type of Substructure	Reversed-T type Abutment, 2-column Pier
Type of Foundation	Cast in Place Concrete Pile, Dia. 1.50m

iv) Geometry of Approach Span Bridge (Can Tho side, P17 ~ A2)	
Type of Superstructure	
P17 ~ P36	3, or 4-spans Continuous Composite PC I Girder
P36 ~ P41	5 spans Continuous PC Box Girder (Balanced Cantilever Method)
P41 ~ A2	2-spans Continuous Composite PC I Girder
Span Arrangement	
P17 ~ P36	19@40=760m
P36 ~ P41	50m+3@80m+50m=340m
P41 ~ A2	2@40m=80m
Type of Substructure	Reversed-T type Abutment, 2-Columns Pier
Type of Foundation	Cast in Place Concrete Pile Dia. 1.50m & 2.00m

c) Typical Cross Sections

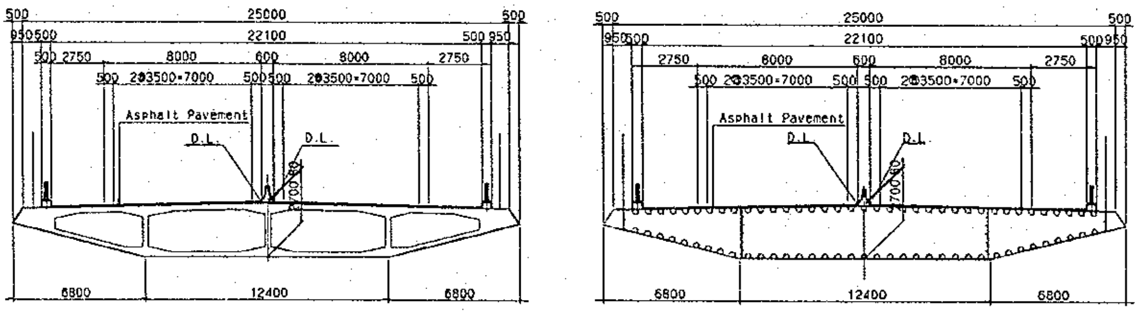


Figure 7.10 Main Bridge (PC Box Girder & Steel Box Girder)

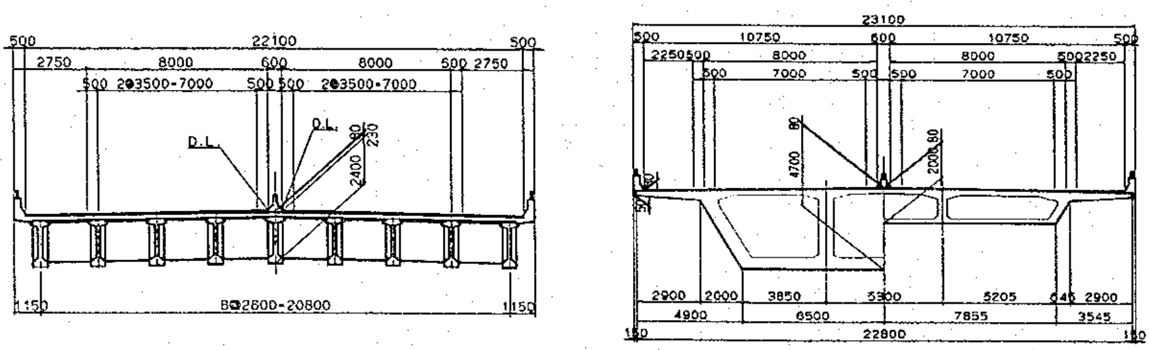


Figure 7.11 Approach Viaduct (PC Composite I Girder & PC Box Girder)

d) Material

i) Concrete

Table 7.11 Design Class of Concrete

Class	fc′	Typical use	
A	50 MPa	Pre-cast concrete:	Segments of PC Box Girders
B	40 MPa	In situ concrete:	Pylons, PC Box Girders,
		Pre-cast concrete:	I Girders
(C)	35 MPa	In situ concrete:	PRC hollow slabs
D	30 MPa	In situ concrete:	Diaphragm for PC I-girder, Cast in Place Concrete pile
		Pre-cast concrete:	Skirting Unit and Precast Slab for Piers in River and Pilecaps of Pylons
E	24 MPa	Pre-cast concrete:	Concrete Barrier & Curb
		In situ concrete :	Pier, Abutment, Pile caps
F	20 MPa	In situ concrete :	Concrete foot-path
G	15 MPa	In situ concrete :	Lean Concrete, Plain Concrete

Class	fc′	Ec (MPa)	G (MPa)	Ct
A	50MPa	33,900	14,100	10.8/°C x 1.0E-6
B	40MPa	30,400	12,600	
C	35MPa	28,400	11,800	
D	30MPa	26,300	10,900	
E	24MPa	24,000	10,000	
F	20MPa	21,500	8,900	
G	15MPa	18,600	7,700	

Notes: fc′: Compressive Strength of Concrete at 28 days (LRFD 5.4.2.1)

Ec: Elasticity Modulus of Concrete (LRFD 5.4.2.4)

$Ec = 0.043Yc^{1.5}\sqrt{fc'}$

$Ec=4800\sqrt{fc'}$

G: Shear Modulus (LRFD5.4.2.5)

G = Ec/(2 x (1+Poisson's ratio)) = Ec/2.4

Ct: Coefficient of thermal expansion and contraction (LRFD5.4.2.2)

ii) Reinforcement Steel

- Specified Yield Strength:
  - Plain Round Bar: 235MPa
  - High Yield Deformed Bar: 390MPa
- Modulus of Elasticity: Es = 200,000 MPa

iii) PC Steel

Table 7.12 Feature of PC Steel

	Internal PC Strand (Longitudinal)	Internal PC Bar (Longitudinal)	PC Strand in Diaphragm at Stay PC anchorage (Transverse)
Type of PC Steel	12S15.2	PC bar dia.32mm	12S15.2
Sectional Area (mm^2)	1,664.5	804.2	1664.5
Nominal Strength (N/mm^2)	1,860	1,180	1,860
Yield Strength (N/mm^2)	1,570	930	1,570
Young's Modules (MPa)	196,000	197,000	196,000
Friction Loss Coefficient (/m)	0.002	0.002	0.002
Angle Coefficient (/Deg.)	0.25	0.25	0.25
Set Losses (mm)	9	0	9

iv) Stay Cable

$$E = \frac{E_0}{1 + \frac{(\gamma \bullet 1 \bullet \cos\alpha)^2 \bullet (\sigma_1 + \sigma_2)}{24\sigma_1^{\ 2} \bullet \sigma_2^{\ 2}}}$$

Where, E : Elastic modulus of Stay Cable In the case that sag is considered

E_0 : Elastic modulus of Stay Cable

γ : Unit weight of Stay Cable

l : Stay Cable length

α : Inclining Angle

σ : Tensile stress of Stay Cable

Limited Stress:

0.40 fp: (Under Maximum Combination of the Service Loads)

0.60 fp: (During Construction Stage)
(In case of Stay Cable Exchange or Removal)

Table 7.13 Steel Properties of Stay Cable

Material	Nom. ld	Area	Guaranteed Ultimate Tensile Strength f_p	Guaranteed Ultimate Force P_B	Service Limit Force
	Mm	Mm^2	MPa	kN	kN
Strand	15.2	140	1862	261	104

(2) Major Load

a) Dead Load

Dead Loads were estimated based on the following items:

- Standard Unit Weights indicated on the Design Criteria
= Estimated Quantities based on the Design Analysis

b) Live Load

As the design traffic load, the B Live Load defined on the "Standard Specification of Highway Bridges of Japan Road Association (hereinafter, referred to as "SHB-JRA")" was applied. The detail of B Live Load was described in the Design Criteria attached to the Annexure.

There are two types of B Live Load defined in SHB-JRA, and they are to be applied for the specified design portions.

"T Load" was applied for the design of deck slabs and floor structures, and "L Load" was applied for the design of main girders in the longitudinal direction.

Moreover, the "Dynamic Load Allowance" and "Braking Force" were considered being included in the Live Load. They were estimated based on both of the AASHTO LRFD and SHB-JRA. The theories of them were described in the Design Criteria.

Dynamic load allowance was calculated and applied based on STB-JRA for Main Bridge (Cable Stayed Bridge), and based on AASHTO LRFD for other bridges.

Table 7.14 Summary of Dynamic Load Allowance

Bridge	Applied Standard	Impact Coefficient
Main Bridge (Cable Stayed Bridge)	STB-JRA	
- Center Span (550m)	STB-JRA	I = 0.033
- Side Span (P14 ~ Northern Pylon) (P15 ~ Southern Pylon)	STB-JRA	I = 0.111
- Side Span (P14 ~ Northern Pylon) (P15 ~ Southern Pylon)	STB-JRA	I = 0.111
Approach Viaduct and other bridges	AASHTO LRFD	I = 0.33

Braking forces shall be taken as 25% of the axle weights of the design truck or tandem per lane placed in all design lanes which are considered to be loaded in accordance with number of design lane and which are carrying traffic headed in the same direction. These forces shall be assumed to act horizontally at a distance of 1800 mm above the roadway surface in either longitudinal direction to cause extreme force effects. All design lanes shall be simultaneously loaded for bridges likely to become one-direction in the future.

The multiple presence factors specified in Table 7.15 shall apply.

Table 7.15 Multiple Presence Factor " m"

Number of Loaded Lanes	Multiple Presence Factor "m"
1	1.2
2	1.0
3	0.85
>3	0.65

c) Thermal Effect

The Study Team analyzed the collected data to define the design temperature with 30 or 40 years return periods. The results are shown in the following.

Static Method: Iwai Method (Japanese)

Table 7.16 Records and Analyzed Temperatures

	Design Criteria	For 30 years return period	For 40 years return period	For 100 years return period
- Maximum	36.7 °C	37.3 °C	37.4 °C	37.8 °C
- Minimum	17.7 °C	17.0 °C	16.9 °C	16.6 °C
- Range	19.0 °C	20.3 °C	20.5 °C	21.2 °C
- Average	26.7 °C	26.7 °C	26.7 °C	26.7 °C
Design Thermal Effect	+15 °C ~ -15 °C	+10.6°C ~ -9.7°C	+10.7°C ~ -9.8°C	+11.1°C ~ -10.1°C

* Note: Temperature Data utilized for the static analysis were procured from Can Tho Station.

As the feature of the climate of tropical regions, there is not much difference in the yearly range of the temperature. Moreover, the average monthly temperatures are also not different much.

Considering the above results, the design conditions of the structures are defined as shown below:

Design Thermal Effect (Thermal Range): ±15°C

Differential Temperature: 5°C

d) Creep and Shrinkage

The effects of creep and shrinkage caused in the PC Girder during construction were considered as a part of Dead Load in the 2-D Frame Analysis.

e) Wind Load

The statistic wind velocities based on the collected wind records for Can Tho Bridge and My Thuan Bridge were shown in the following;

Return Period: 50 years

Static Method: Gringorten Method for Can Tho Bridge

Table 7.17 Comparison of the Statistic Wind Velocities
(Can Tho & My Thuan Bridge)

Static Velocity	V10 (m/sec)			Vg(m/sec)		
Z (m)	10.0	40.0	100.0	10.0	40.0	100.0
Can Tho Bridge	31.3	38.8	44.8	43.8	49.7	52.8
My Thuan Bridge	26.0	32.0	38.0	41.0	48.0	53.0

* Note: V10: Average wind velocity per 10 minutes Vg: Wind velocity considering the Gust
Z : Height from ground level
Wind records utilized for the static analysis of the Can Tho Bridge were procured from Can Tho Station. Static Data of My Thuan Bridge were quoted from the Design Report of My Thuan Bridge Project

As shown in the above table, the static wind velocities of Can Tho Bridge and My Thuan Bridge are almost similar.

Moreover, the results of the statistical analysis for 100 years of return periods shown in the following:

Table 7.18 Statistic Wind Velocity for Can Tho Bridge

(Return Period: 100years)

Station	Iwai Method	Gringorten Method	Gumbel Method
Can Tho (1978-1998)	35.6m/sec	35.2m/sec	37.4m/sec
Soc Tran (1949-1998)	30.2m/sec	24.5m/sec	29.8m/sec

Considering the results of the statistical analysis, the basic design wind velocity applied for Can Tho bridges is as follows:

U_{10} = 40m/sec = about 100mile/sec, at 10m height from ground level

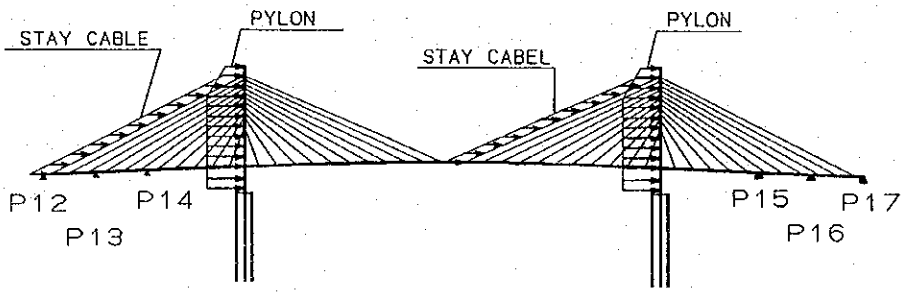
Moreover, the compensating rate defined in Wind-proof Design Standard of Japan is as shown in follows:

Classification of resistance for surface of the earth: II

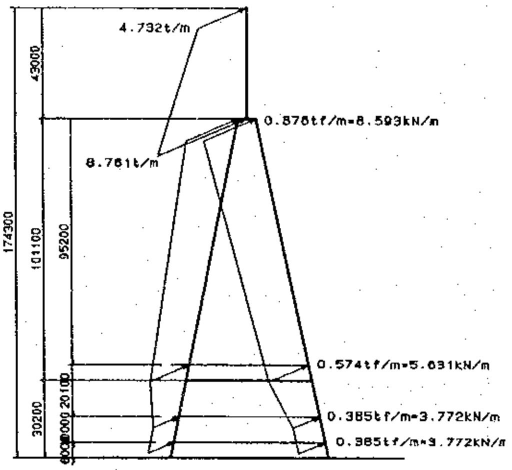
Altitude of a target (Girder) = 42.8m (40<z<45m)

Compensating Rate:	Classification of resistance for surface of the earth: II Altitude of a target(Girder): 42.8m (40<z<45m) Compensating Rate: E_1 = 1.26
Design Wind Velocity:	$U_d = U_{10} \times E_1$ = 50.4m/sec

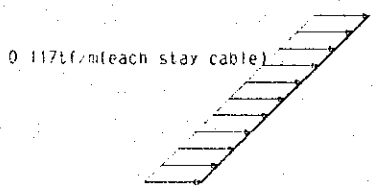
The design wind loads are summarized and indicated in Figure 7.12 and Figure 7.13.



Longitudinal Direction



Wind Load for Pylon



Wind Load for Stay Cable

Figure 7.12 Design Wind Load in Longitudinal Direction for Static Analysis

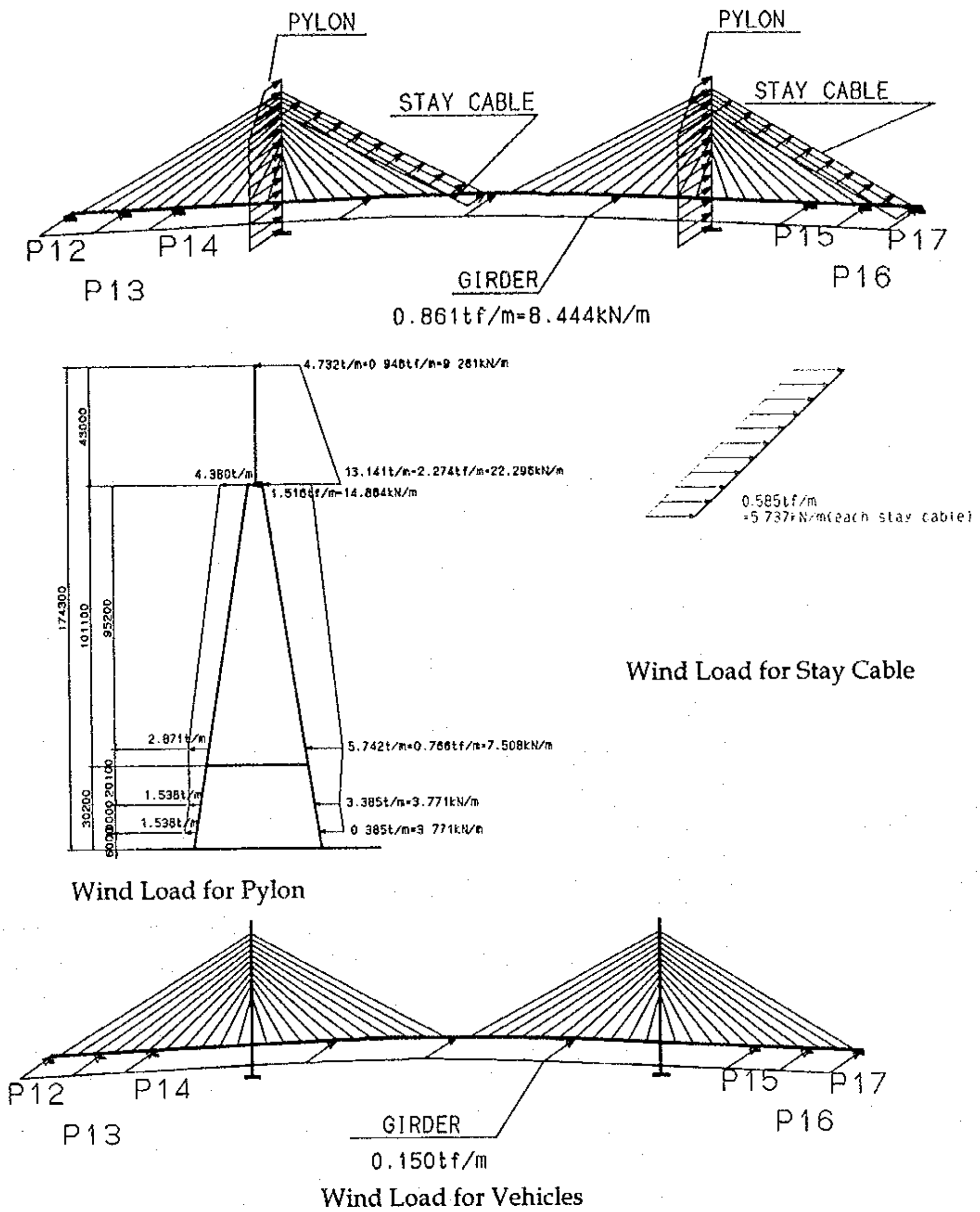


Figure 7.13 Design Wind Load in Transverse Direction for Static Analysis

f) Vessel Collision Force

Because of the absence of actual accident data as explained in the Meeting, the Study Team defined the design vessel collision force with utilizing the actual arrival ship record to the Can Tho Port.

The estimation method of the Vessel Collision Force is described in the Design Criteria, and the results of calculation are shown in the following table & figure:

Table 7.19 Ship Impact Force for Substructure

unit : kN

Substructure	Longitudinal	Transverse
Southern Pylon	27,870	55,470
Pier P15	11,520	23,040
Pier P16	8,690	17,380
Pier P17	8,490	16,970
Pier P36	3,250	6,500
Pier P37	4,370	8,750
Pier P38	6,630	13,260
Pier P39	6,630	13,260
Pier P40	4,370	8,750
Pier P41	3,250	6,500

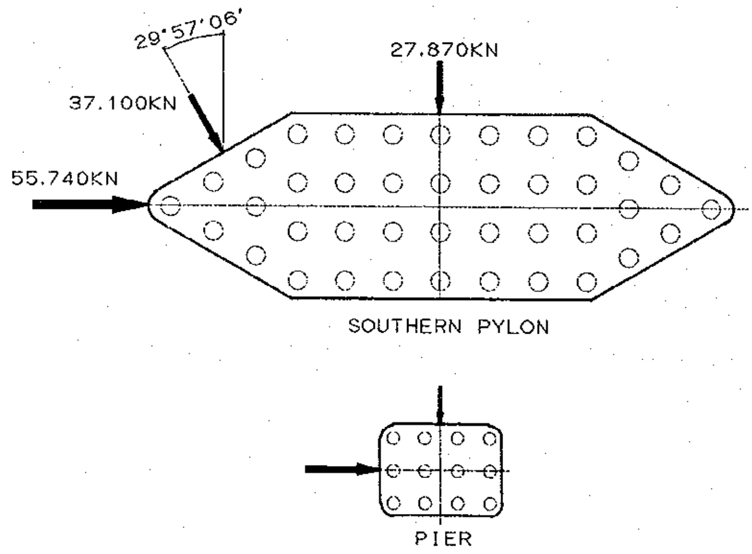


Figure 7.14 Loading Direction of the Vessel Collision Force

g) Seismic Force

The Institute of Geophysics suggested that the earthquake effect (ground acceleration) should be between 0.07g and 0.12g. The design seismic coefficient should be based on the further study on the seismic intensity of 1,000 year (0.07g for the Project Area) and the consideration on geotechnical condition and the importance of the structure.

Following the above suggestions, the JICA Study Team calculated the elastic seismic response coefficient with the above ground acceleration in accordance with AASHTO Specifications with a soil magnification factor. The calculated design seismic coefficient in accordance with AASHTO Specifications was shown in the following:

Reference: AASHTO LRFD BRIDGE DESIGN SPECIFICATION, SI Units Second Edition 1998 (hereinafter, AASHTO LRFD), Section 3 - Loads and Load Factors, 3.10 EARTHQUAKE EFFECTS: EQ

i) Categorization

The bridge structures of this project were categorized into the following 3 categories to study the seismic coefficient based on AASHTO LRFD;

Table 7.20 Type of Structures

Structure and Package		Type of Structure
1) Main Bridge	Package-2	Hybrid Cable Stayed Bridge
2) Approach Span Bridges	Package-2	PC I beam & PC Box Girder
3) Minor Bridges	Package-1&3	PC I beam, PC Box Girder, PRC Hollow Slab

ii) Formula (AASHTO LRFD, Section 3.10.6)

Table 7.21 C_{sm} defined in AASHTO LRFD

Period of Vibration (sec)	Formula
$T_m > 4.0$	$C_{sm}=3AS / T_m^{4/3}$
$0.3 < T_m < 4.0$	$C_{sm}=1.2AS / T_m^{2/3} \leqq 2.5A$
$T_m < 0.3$	$C_{sm}=A(0.8+4.0\,T_m)$

* Notes: C_{sm}: Elastic Seismic Response Coefficient
T_m: Period of Vibration of the m^{th} mode (sec)
A: Acceleration Coefficient
S: Site Coefficient

iii) Acceleration Coefficient, A (AASHTO LRFD, Section 3.10.2)

On AASHTO LRFD, the acceleration coefficient was defined on the contour map, only for United States of America. In this project, with considering this contour map, this coefficient was defined with considering the return-period of earthquake and the importance of structures as follows:

Table 7.22 Acceleration Coefficient of Structures

Structure and Package		A	Evaluation
1) Main Bridge	Package-2	0.12	Importance: Very High Return Period: 1000 years
2) Approach Span Bridges	Package-2	0.06	Importance: High Return Period: 1000years
3) Minor Bridges	Package-1&3	0.05	Importance: Medium Return Period: 500 years

iv) Site Effects, S (AASHTO LRFD, Section 3.10.5)

In AASHTO LRFD, the soil property of site was considered in the "Elastic Seismic Response Coefficient" as the "Site Effects", as follows;

Table 7.23 Site Coefficient defined in AASHTO LRFD

Site Coefficient	Soil Profile Type			
	I	II	III	IV
S	1.0	1.2	1.5	2.0

- Soil Property Type I: Rock of any description, either shale-like or crystalline in nature or Stiff soils where the soil depth is less than 60,000mm, and the soil types overlying the rock are stable deposits of sands, gravels, or still clays.
- Soil Property Type II: A profile with stiff cohesive or deep cohesionless soils where the soil depth exceeds 60,000mm and the soil types overlying the rock are stable deposits of sands, gravels, or stiff clays
- Soil Property Type III: A profile with soft to medium-stiff clays and sands, characterized by 9,000mm or more of soft to medium-stiff clays with or without intervening layers of sand or other cohesionless soils
- Soil Property Type IV: A profile with soft clays or silts greater than 12,000mm in depth. In this project, whole of structures are categorized into "Soil Property Type IV", and the Site Effect, S was decided as "2.0".

v) Period of Vibration, T_m

The period of vibrations of the three categories are summarized as follows:

Table 7.24 Period of Vibration of Structures

Structure and Package		T_m (sec)
Main Bridge (Hybrid Cable Stayed Bridge) * Refer to Appendix-1	Package-2	1st Mode: 6.78 2nd Mode: 5.47 3rd Mode: 4.00
Approach Span Bridges (PC I beam & PC Box Girder)	Package-2	0.5 sec ~ 1.5 sec, approximately
Minor Bridges (PC I beam, PC Box Girder, & PRC Hollow Slab)	Package-1&3	1.0 sec, approximately for whole bridges

For 1) Main Bridge, the 3rd Mode was regarded as the critical mode for the structure analysis. The summary of dynamic analysis was shown on Appendix - 1.

vi) Elastic Seismic Response Coefficient, C_{sm} (AASHTO LRFD, Section 3.10.6)

Based on the above conditions, the Elastic Seismic Response Coefficients were calculated as follows:

Table 7.25 Elastic Seismic Response Coefficient of Structures

Structure	T_m (sec)	Formula	A	S	C_{sm}
1) Main Bridge	4.0	$C_{sm}=3AS / T_m^{4/3}$	0.12	2.0	0.113
2) Approach Bridges	0.5	$C_{sm}=1.2AS / T_m^{2/3} \leqq 2.5A$	0.06	2.0	0.150
	1.0	$C_{sm}=1.2AS / T_m^{2/3} \leqq 2.5A$	0.06	2.0	0.144
	1.5	$C_{sm}=1.2AS / T_m^{2/3} \leqq 2.5A$	0.06	2.0	0.110
3) Minor Bridges	1.0	$C_{sm}=1.2AS / T_m^{2/3} \leqq 2.5A$	0.05	2.0	0.120

vii) Elastic Seismic Response Coefficient applied for Design

With considering the calculated C_{sm} and the suggestion of the institute of Geophysics, the following conclusion was derived for the design:

- Main Bridge
  The estimated C_{sm} based on AASHTO LRFD was 0.113.

In the application of seismic forces defined in AASHTO LRFD, Section 3.10.8, the combination of seismic force effects is to be examined, for the longitudinal and transverse directions. It means that the 100% of longitudinal seismic force and 30% of transverse seismic force should be examined in the design analysis at the same time.

In this project, to simplify the design analysis, the seismic forces in longitudinal and transverse directions are separately examined, with applying the Japanese Standards.

With considering the above situations, 0.12 was selected for the design of the Main Bridge.

- Approach and Minor Bridges

  The estimated C_{sm} based on AASHTO LRFD was 0.110 to 0.150.

  Same as the Main Bridge, the seismic forces in longitudinal and transverse directions are separately examined. Moreover, the maximum value of seismic coefficient suggested by the Institute of Geophysics was 0.12.

  With considering the above situations, 0.12 was selected for the design of these bridges.

h) Construction Load Caused by the Erection Equipment for Cable Stayed Bridge

Erection Nose Weight: 1960 kN (200tf)

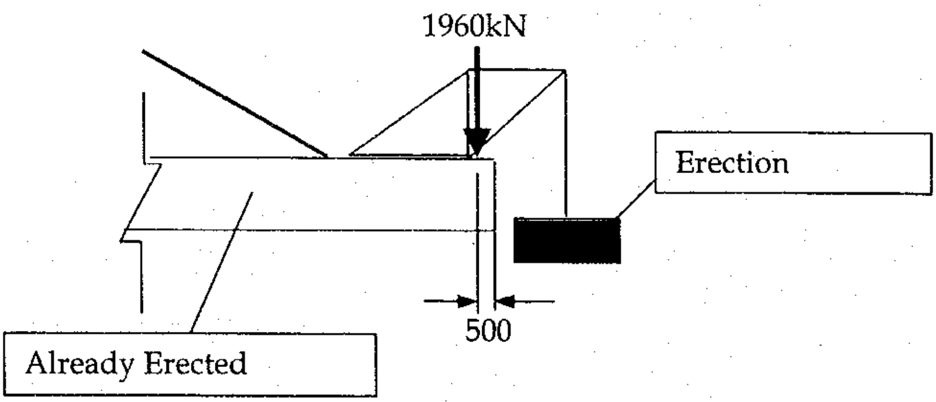


Figure 7.15 General Figure of Loading of the Construction Load

7.3.2 Model of Main Bridge Analysis

(1) 2-Dimensional Frame Model for the Longitudinal Direction

2-Dimensional frame analysis was calculated for sectional force, displacement, stress of complete structure, with considering the erection steps, and creep & shrinkage of superstructure. The results of frame analysis were used for the design of main girder, stay cables and pylon (longitudinal).

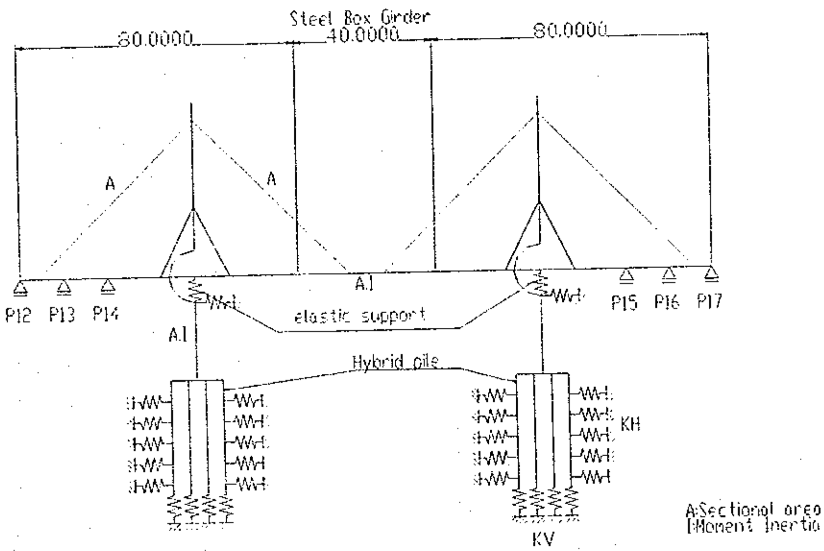


Figure 7.16 2-Dimensional Model of Main Bridge Analysis

(2) 3-Dimensional Frame Model for the Transverse Direction

3-Dimensional frame analysis was used for the design for transverse direction. Outline of 3-Dimensional frame model shown in Figure 7.17, 7 Standpoint of support conditions are same as 2-Dimensional frame analysis model, and some parts of the results of 2-Dimensional analysis, especially the effects of creep & shrinkage occurred during erection were involved and considered.

The purpose of the analysis by space frame is as shown below.

- Design of the section of the transverse direction of pylon.
- Fluctuation of stress of stay cable by life load is confirmed.
- Section design of transverse direction of a main girder.
- Transformation of a main girder is confirmed.

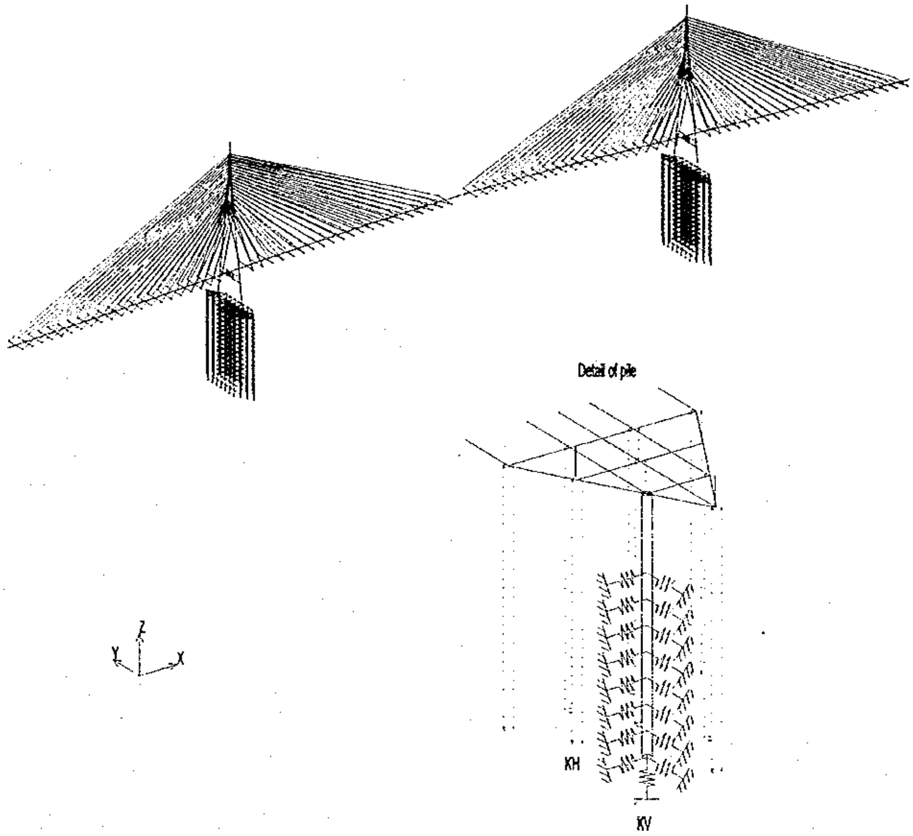


Figure 7.17 3-Dimensional Model of Main Bridge Analysis

7.3.3 Design Results of Girder

(1) Location of the Studied Sections

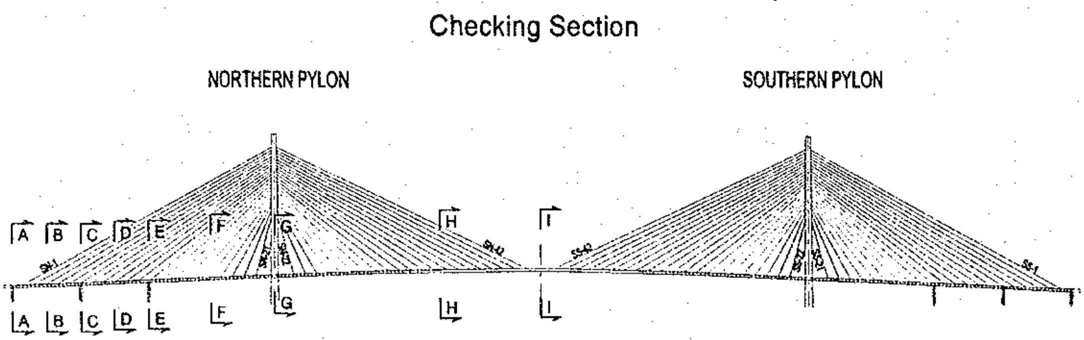


Figure 7.18 Location of the Studied Sections

(2) Applied Load Combination

Strength I	Base load combination relating to the normal vehicular use of the bridge without wind.
Strength II	Load combination relating to owner specified design vehicle
Strength III	Load combination relating to ultimate wind loads
Strength IV	Load combination relating to very high dead load to live load ratio.
Strength V	Load combination relating to live loads and wind loads
Extreme Event I	Load combination relating to earthquake
Extreme Event II	Load combination relating to collisions by vessels and vehicles

(2) Flexural Resistance

Table 7.26 Flexural Resistance

Section	A	B	C	D	E	F	G	H
Mn kNm	45945	235916	509497	276094	644008	405358	278415	132504
ϕ	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Q	728	118860	270929	156106	489417	138373	219188	67863
η	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Strength I	Strength I	Strength I	Strength IV	Extreme I	Strength I	Strength I	Strength I
Mr kNm	43648	224120	484022	262289	611808	385090	264494	125879
Q_M kNm	728	118860	270929	156106	489417	138373	219188	67863
	OK	OK	OK	OK	OK	OK	OK	OK

(4) Axial Resistance

Table 7.27 Axial Resistance

Section	A	B	C	D	E	F	G	H
P_n kN	751475	668867	792848	668038	788710	661420	1118865	673611
ϕ	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Q kN	6662	46879	82807	115115	135515	177273	203103	63081
η	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Extreme I	Strength IV	Strength IV	Strength I	Strength I	Strength I	Strength IV	Strength I
P_r kN	676328	601980	713563	601234	709839	595278	1006979	606250
Q_N kN	6662	46879	82807	115115	135515	177273	203103	63081
	OK	OK	OK	OK	OK	OK	OK	OK

(5) Shear Resistance

Table 7.28 Shear Resistance

Section	A	B	C	D	E	F	G	H
V_c (N)	754726	503151	754726	503151	754726	503151	1285829	503151
V_s (N)	22248675	22248675	22248675	22248675	22248675	22248675	22248675	22248675
V_p (N)	0	0	0	0	0	0	0	0
V_n (kN)	754726	503151	754726	503151	754726	503151	1285829	503151
ϕ	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Q (kN)	12516	6832	19340	7261	23652	11246	22658	4396
η	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Srength I	Srength I	Strength IV	Srength I	Srength I	Srength I	Srength I	Srength I
V_r (kN)	679253	452835	679253	452835	679253	452835	1157246	452835
Q_S (kN)	12516	6832	19340	7261	23652	11246	22658	4396
	OK	OK	OK	OK	OK	OK	OK	OK

7.3.4 Design Results of Pile Cap of Pylons

(1) Analyzed Model

The structural model of pilecap was defined as shown in the following figure. The pilecap structure was divided into 13 lines in the longitudinal direction, and 7 lines in the transverse direction, based on the arrangement of piles and bottom of column of pylon. The spring constants given for each node of the analyzed model are as shown below:

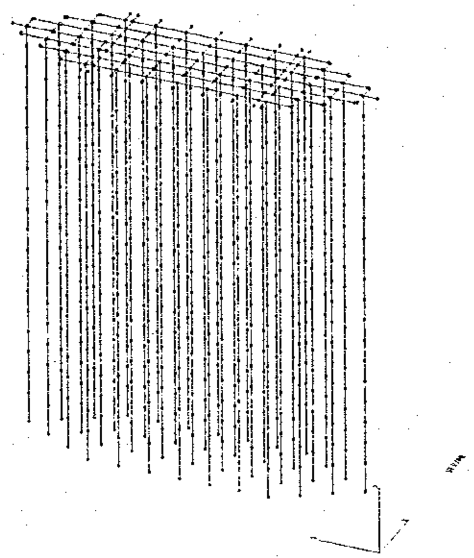


Figure 7.19 Frame Model of Pile Cap and Piles

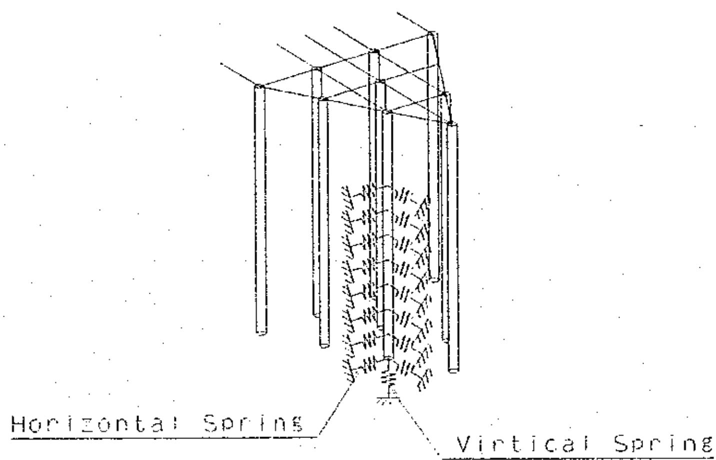


Figure 7.20 Detail Model of Spring affected to Piles

(2) Spring Constant of Piles

Table 7.29 Horizontal Spring Constant

Northern Pylon					Southern Pylon				
depth (m)	A (m2)	I (m2)	kh:(kN/m) Ordinary	kh:(kN/m) Earthquake	depth (m)	A (m2)	I (m2)	kh:(kN/m) Ordinary	kh:(kN/m) Earthquake
5	9.863	7.431	0	0	7.1	9.863	7.431	0	0
10	9.863	7.431	0	0	12.1	9.863	7.431	0	0
15	9.863	7.431	0	0	17.1	9.863	7.431	0	0
20	9.863	7.431	0	0	22.1	9.863	7.431	0	0
25	9.863	7.431	80542	161094	27.1	9.863	7.431	0	0
30	9.863	7.431	161094	322188	32.1	9.863	7.431	80542	161094
35	9.863	7.431	161094	322188	37.1	9.863	7.431	161094	322188
40	9.863	7.431	161094	322188	42.1	9.863	7.431	161094	322188
45	9.863	7.431	161094	322188	47.1	9.863	7.431	161094	322188
50	7.069	3.976	235889	471788	52.1	9.863	7.431	161094	322188
55	7.069	3.976	324600	649200	57.1	7.069	3.976	261975	523950
60	7.069	3.976	324600	649200	62.1	7.069	3.976	415194	830388
65	7.069	3.976	324600	649200	67.1	7.069	3.976	415194	830388
70	7.069	3.976	787474	1574948	72.1	7.069	3.976	874704	1749418
75	7.069	3.976	1090951	2181901	77.1	7.069	3.976	1090951	2181901
80	7.069	3.976	1090951	2181901	82.1	7.069	3.976	1090951	2181901
85	7.069	3.976	1527327	3054654	87.1	7.069	3.976	1069131	2138262
90	7.069	3.976	498227	996464	92.1	7.069	3.976	1080036	2160081
97	7.069	3.976	763663	1527327	97	7.069	3.976	459412	918834

Table 7.30 Vertical Spring Constant

Pylon	Kv (kN/m)
Northern Pylon	12988398
Southern Pylon	11985541

(3) Design Sections

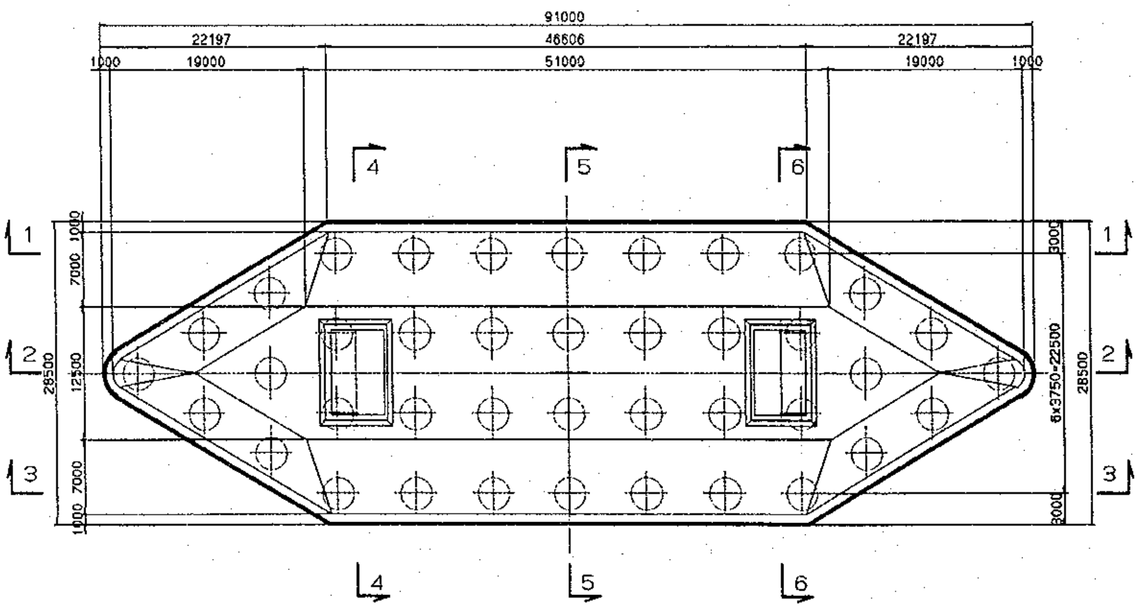


Figure 7.21 Design Sections of Pilecap

(4) Loading Conditions

Considered loads for the pilecap analysis are, dead loads, thermal effect, wind load, seismic force, and vessel collision forces. These forces were combined with considering the load combinations defined in the AASHTO LRFD.

(5) Results of the Sectional Forces

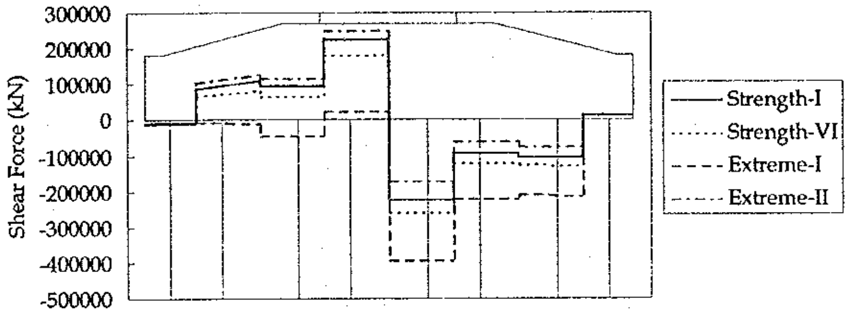


Figure 7.22 Shear Diagram in the Longitudinal Direction

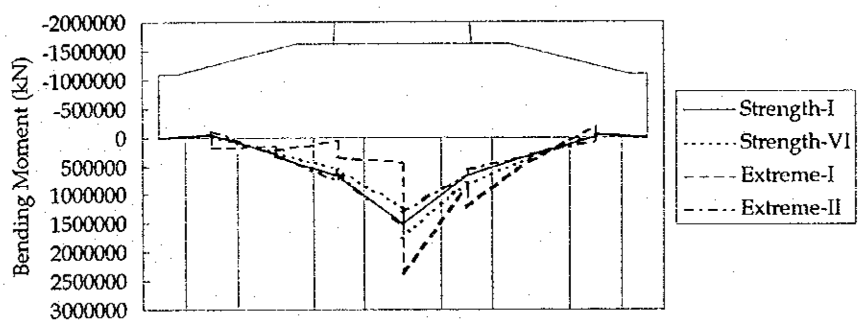


Figure 7.23 Moment Diagram in the Longitudinal Direction

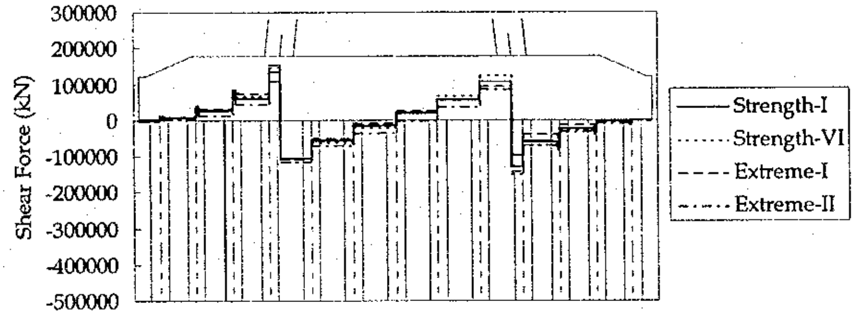


Figure 7.24 Shear Diagram in the Transverse Direction

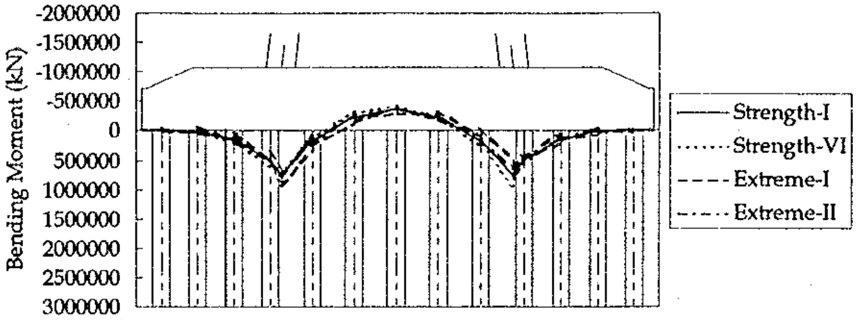


Figure 7.25 Moment Diagram in the Transverse Direction

(6) Flexural Resistance of Pilecap

Table 7.31 Moment and Resistance Factor of Pilecap (Northern Pylon)

Longitudinal Direction

	Section 1-1		Section 2-2		Section 3-3	
	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)
Strength 1	-56266	1722080	1508233	2806274	-57755	1722080
Strength 5	-87357		1747605		-87567	
Extreme 1	197941		2375789		201420	
Extreme 2	-136089		1290127		27798	

Transverse Direction

	Section 4-4		Section 5-5		Section 6-6	
	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)
Strength 1	750944	1581899	-369882	1581899	761224	1581899
Strength 5	750256		-305979		825775	
Extreme 1	937005		-286241		764597	
Extreme 2	779465		-294419		643623	

Table 7.32 Moment and Resistance Factor of Pilecap (Southern Pylon)

Longitudinal Direction

	Section 1-1		Section 2-2		Section 3-3	
	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)
Strength 1	-42444	1489222	1631040	2528508	-64189	1489222
Strength 5	-46418		1841498		-91250	
Extreme 1	265010		2571596		252046	
Extreme 2	53034		1600917		-155618	

Transverse Direction

	Section 4-4		Section 5-5		Section 6-6	
	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)	Moment (kNm/m)	Resistance Factor (kNm)
Strength 1	703107	1245621	-344586	1245621	713316	1245621
Strength 5	721721		-402084		797734	
Extreme 1	913696		-264544		775349	
Extreme 2	786815		-278730		621271	

7.3.5 Design Results of Pile of Pylons

(1) Design Soil Condition and Bearing Capacities

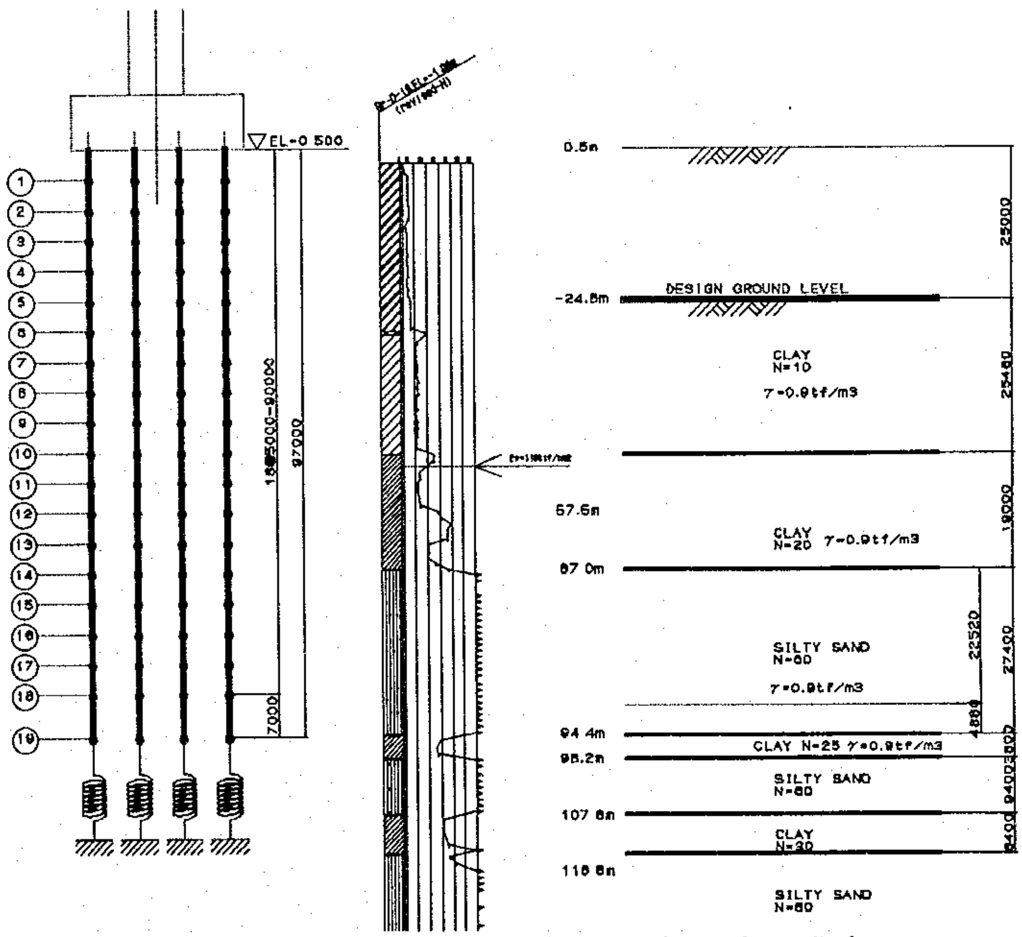


Figure 7.26 Design Soil Conditions of Northern Pylon

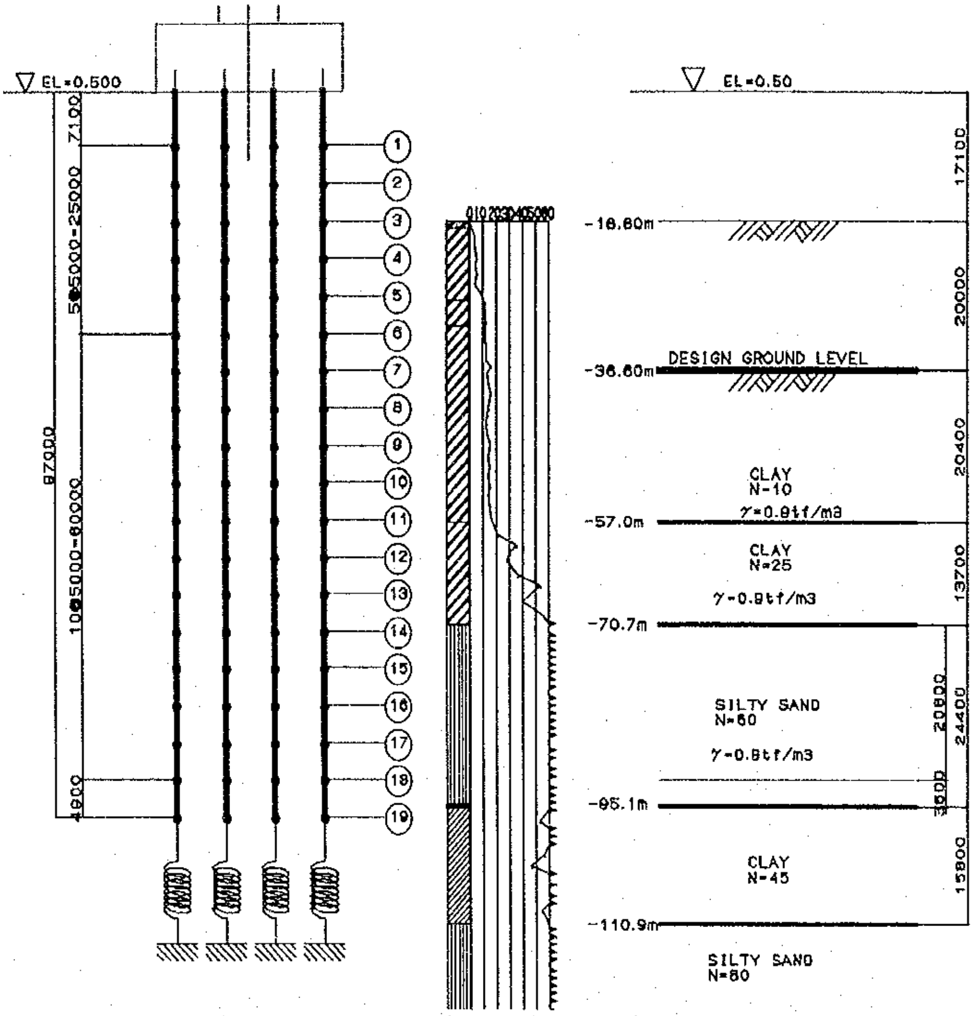


Figure 7.27 Design Soil Condition of Southern Pylon

Table 7.33 Bearing Capacity of Pile

	Northern Pylon	Southern Pylon
Service Limit State	28,458.5 (kN)	38,059.8 (kN)
Strength Limit State	46,127.3 (kN)	55,165.8 (kN)
Extreme Event Limit State	46,127.3 (kN)	55,165.8 (kN)

Table 7.34 Bearing Capacity and Reaction Force of Piles (Northern Pylon)

Pile	Load Combination	Axial Force (Kn)		Shear-Force (kn)		Morment (knm)		Remarks
		max	min	Y	Z	Y	Z	
Pile NO.7	Strength- I	-23,329	-22,850	-76	-426	6,170	1,096	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-27,001	-19,412	-41	-789	10,530	356	<Qa=52200KN
	Extreme Event- I	-41,036	-5,373	-41	-2,648	37,937	288	<Qa=52200KN
	Extreme Event- II	-25,494	-22,371	-88	-1,132	16,751	1,381	
	Service- I	-26,438	-19,888	-101	-466	6,145	1,350	<Qa=32500KN
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.10	Strength- I	-22,827	-22,428	-90	424	-6,559	1,442	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-26,078	-18,142	-61	729	-10,744	827	
	Extreme Event- I	-38,622	-3,416	-55	2,524	-38,635	526	
	Extreme Event- II	-20,185	-18,730	1,285	337	-6,469	-23,377	
	Service- I	-25,147	-18,656	-79	652	-9,956	1,154	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.1	Strength- I	-13,329	-13,174	-1,487	-8	-169	22,593	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-13,841	-12,175	-1,329	-298	4,244	20,506	
	Extreme Event- I	-16,580	-11,433	-3,038	963	-16,317	52,620	
	Extreme Event- II	-12,840	-9,565	-1,419	-671	9,325	21,553	
	Service- I	-13,609	-12,205	-1,341	-245	3,062	20,619	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.40	Strength- I	-13,326	-13,174	1,554	-14	-103	-22,667	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-14,199	-13,016	1,841	256	-4,881	-28,458	
	Extreme Event- I	-14,251	-9,082	2,822	-767	10,424	-46,607	
	Extreme Event- II	-16,111	-12,836	2,739	-36	-742	-43,300	
	Service- I	-15,446	-12,607	1,610	-13	-770	-23,531	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	

Table 7.35 Bearing Capacity and Reaction Force of Piles (Southern Pylon)

Pile	Load Combination	Axial Force (Kn)		Shear-Force (kn)		Morment (knm)		Remarks
		max	min	Y	Z	Y	Z	
Pile NO.7	Strength- I	-20,359	-19,856	-42	-148	4,839	1,127	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-23,481	-17,103	-25	-395	8,901	699	
	Extreme Event- I	-39,368	-1,897	-19	-2,265	46,381	481	
	Extreme Event- II	-19,591	-17,826	1,337	-175	5,345	-28,539	
	Service- I	-23,586	-17,291	-46	-160	5,026	1,353	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.10	Strength- I	-23,843	-23,421	-44	114	-2,552	1,193	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-26,494	-20,985	-2	353	-6,554	216	<Qa=43500KN
	Extreme Event- I	-41,627	-4,535	-14	2,145	-42,717	325	<Qa=43500KN
	Extreme Event- II	-25,887	-22,126	-44	750	-15,451	1,189	
	Service- I	-26,195	-21,165	-30	74	-2,046	946	<Qa=26400KN
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.1	Strength- I	-12,415	-12,261	-496	-41	1,635	14,677	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-12,910	-11,262	-354	162	-2,523	12,211	
	Extreme Event- I	-16,680	-9,772	-2,065	608	-8,941	52,672	
	Extreme Event- II	-12,228	-8,324	-496	585	-10,527	14,669	
	Service- I	-12,790	-11,513	-386	106	-1,438	12,770	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	
Pile NO.40	Strength- I	-12,379	-12,225	553	-41	1,635	-14,553	
	Strength- II	-	-	-	-	-	-	
	Strength- III	-	-	-	-	-	-	
	Strength- IV	-	-	-	-	-	-	
	Strength- V	-13,478	-11,651	827	-267	6,102	-20,958	
	Extreme Event- I	-14,646	-9,361	1,942	-794	15,860	-47,721	
	Extreme Event- II	-16,096	-12,192	1,821	-57	1,850	-40,914	
	Service- I	-14,646	-11,790	595	-71	2,128	-15,686	
	Service- II	-	-	-	-	-	-	
	Service- III	-	-	-	-	-	-	

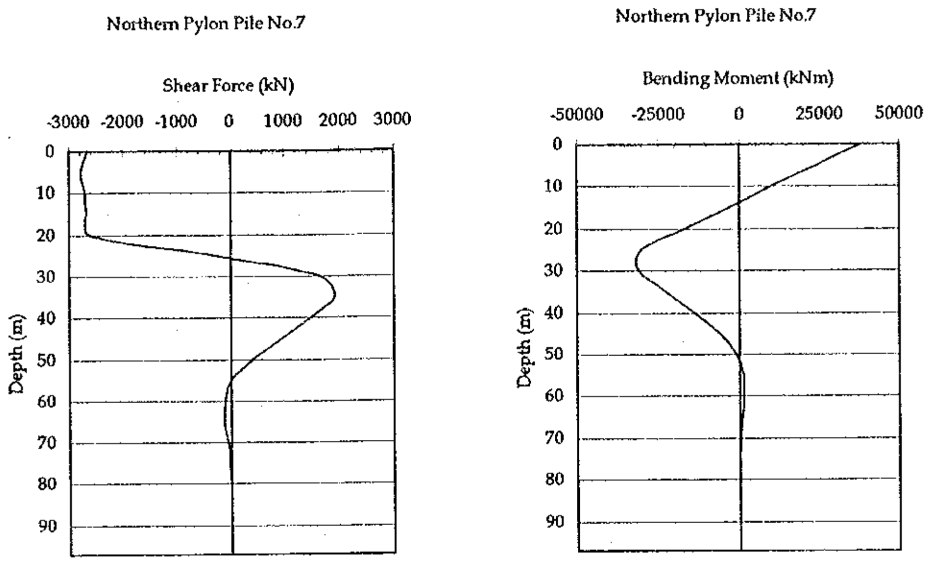


Figure 7.28 Sectional Force Diagram of Pile (Northern Pylon)

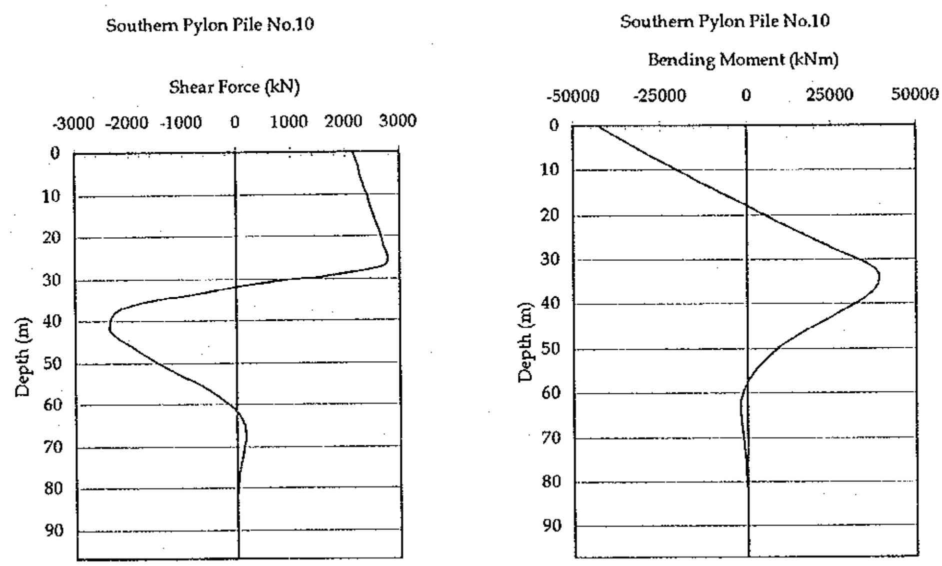
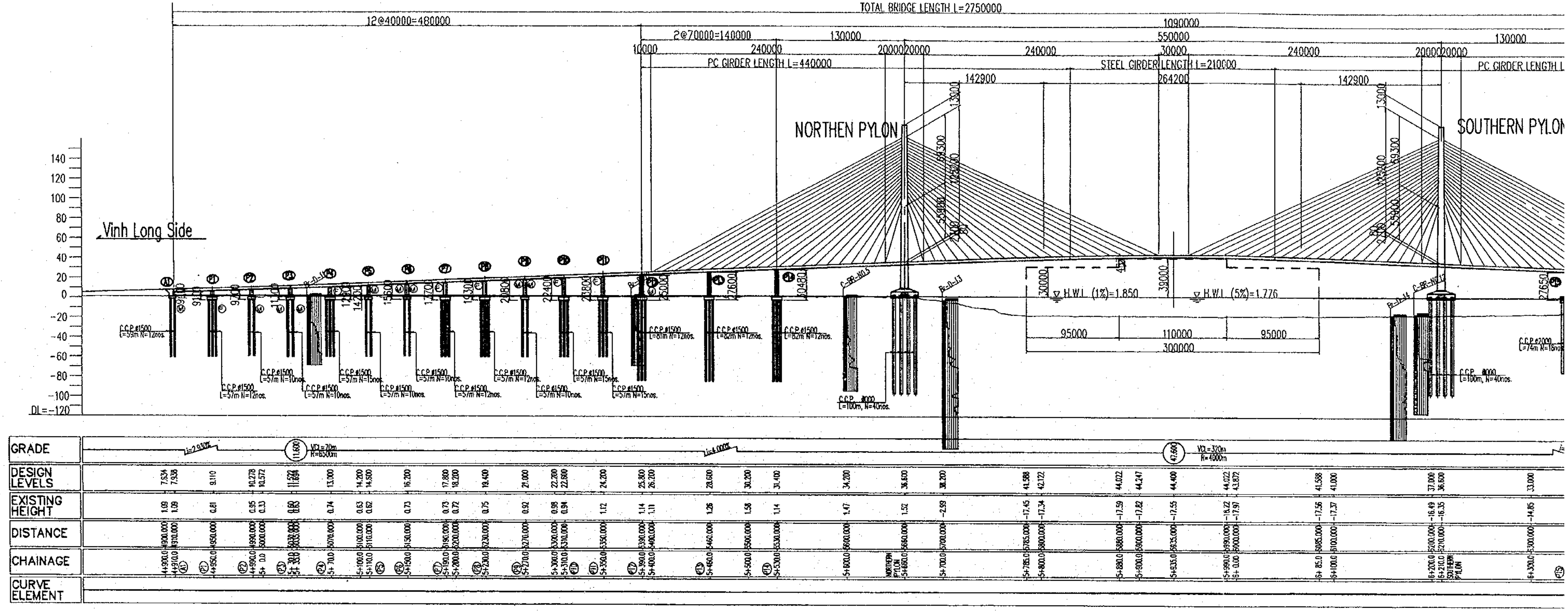
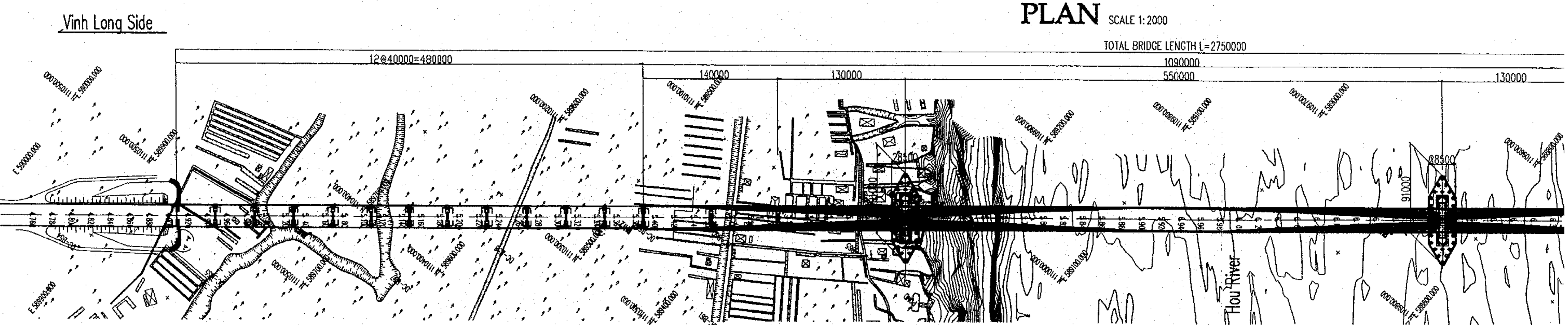


Figure 7.29 Sectional Force Diagram of Pile (Southern Pylon)

SIDE ELEVATION SCALE 1:4000

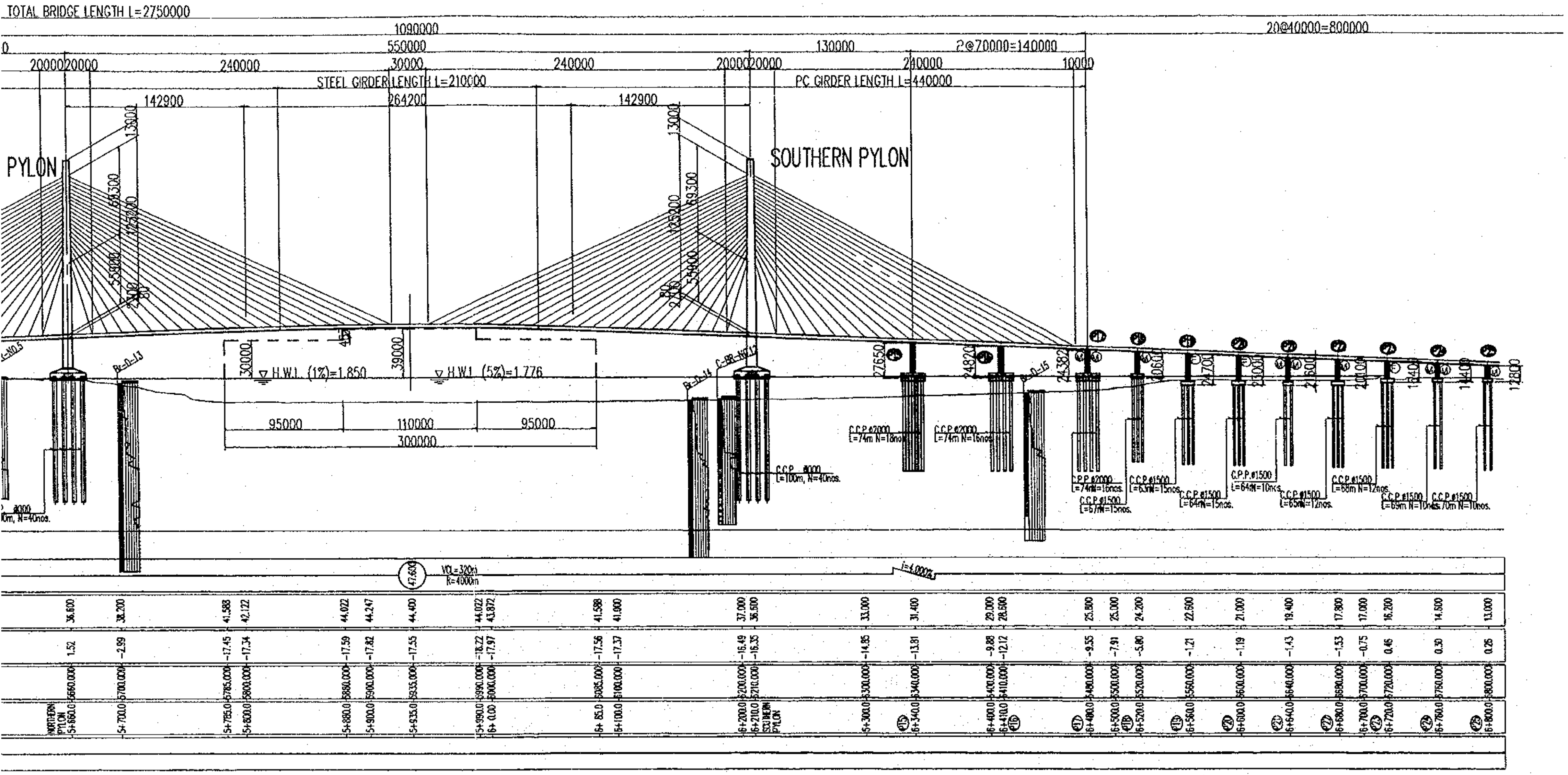


PLAN SCALE 1:2000

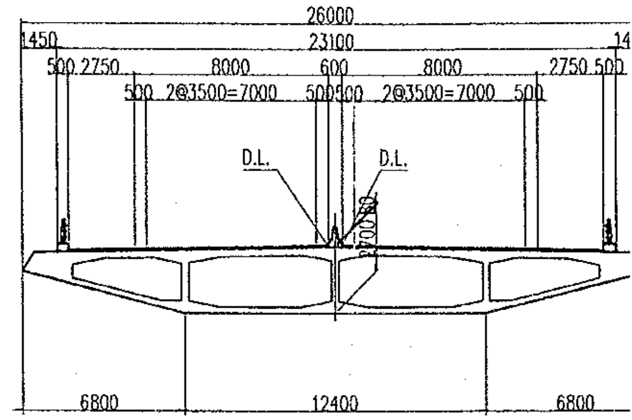


GENERAL VIEW (1/2)

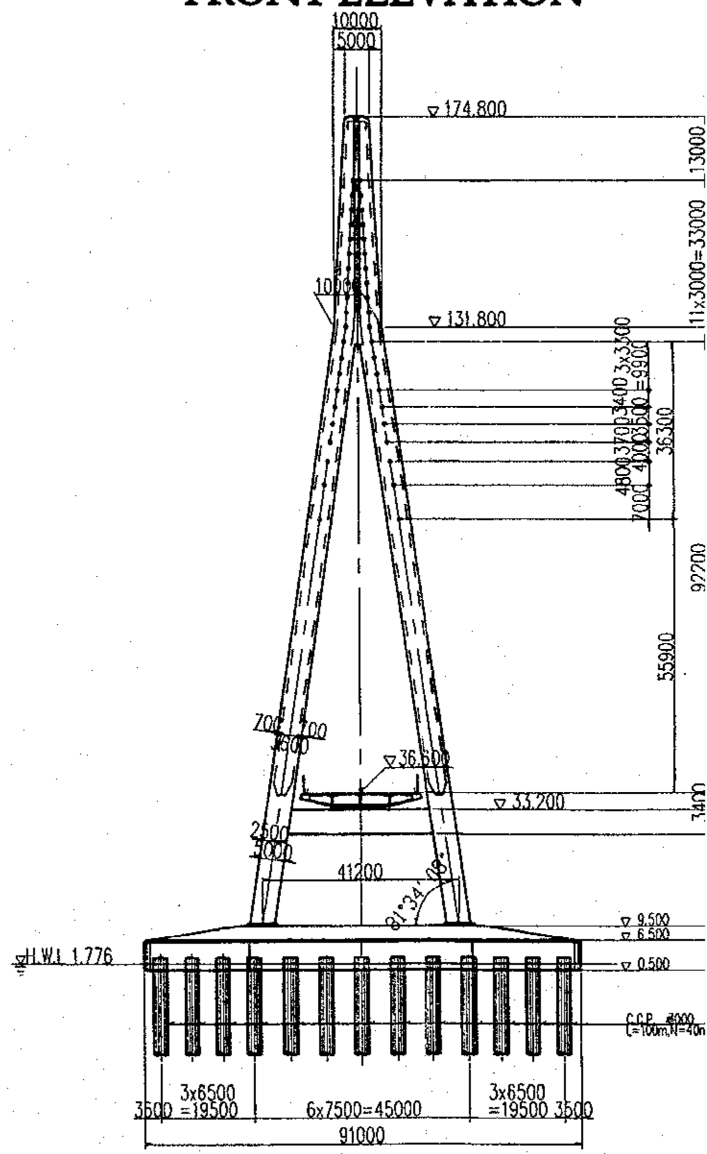
SIDE ELEVATION SCALE 1:4000



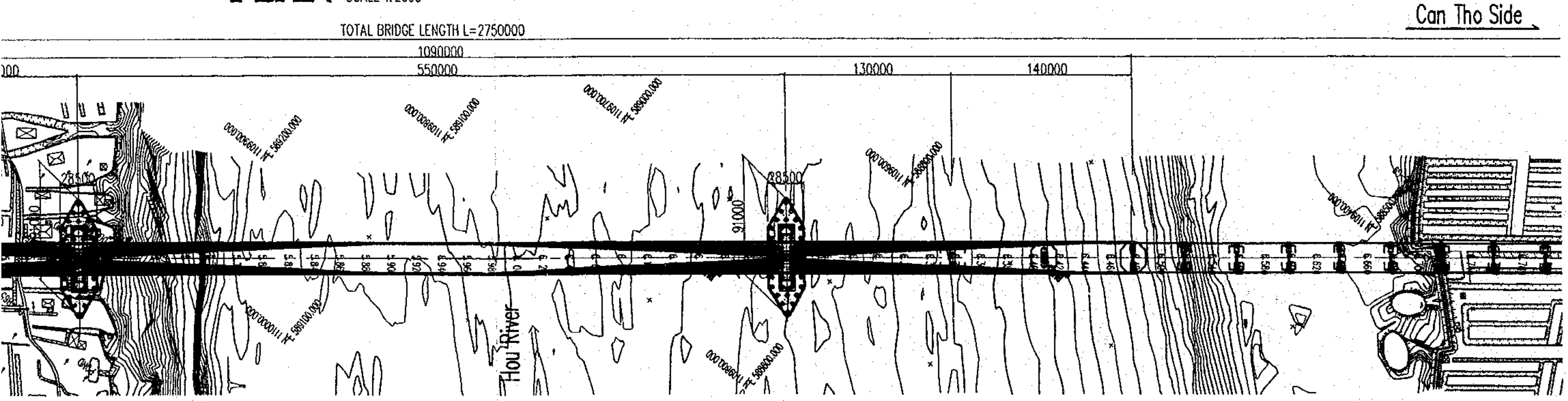
PC BOX GIRDER



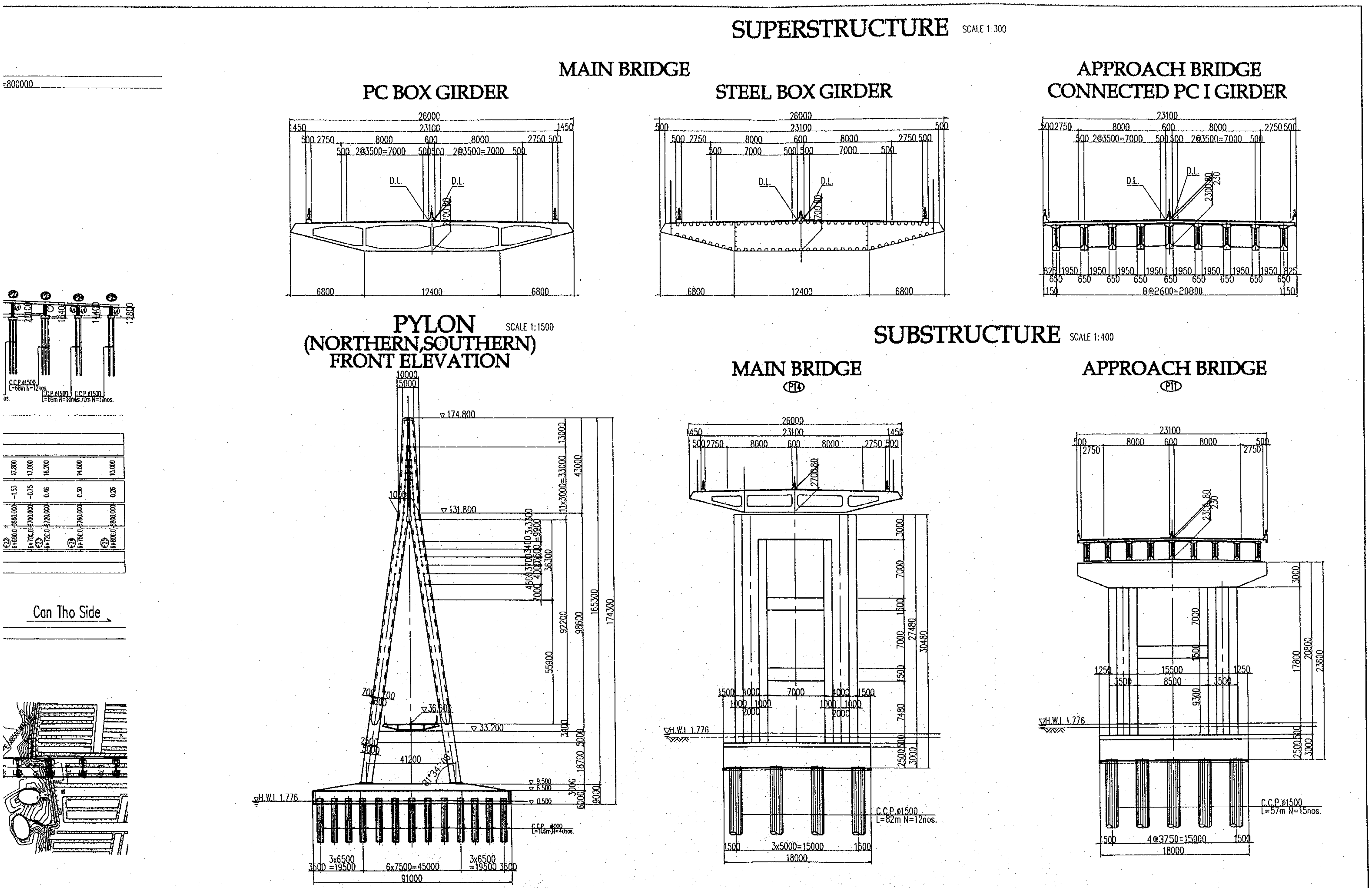
PYLON SCALE 1:1500
(NORTHERN,SOUTHERN) FRONT ELEVATION



PLAN SCALE 1:2000



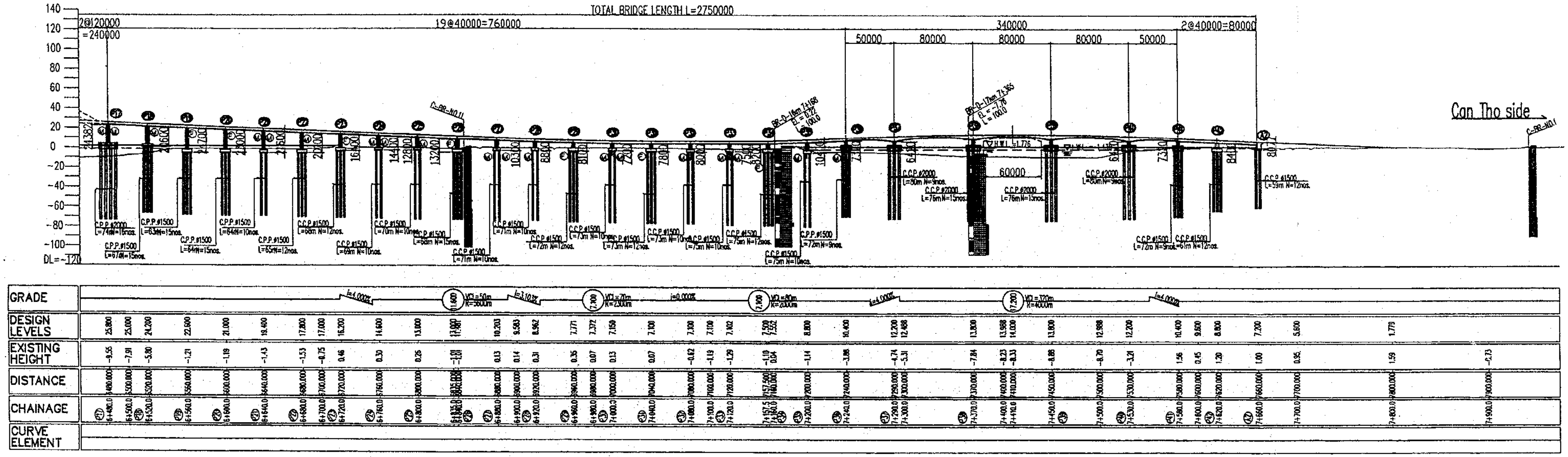
PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGEN
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF MINISTRY OF TRANSPOR MY THUAN PROJECT MANAC



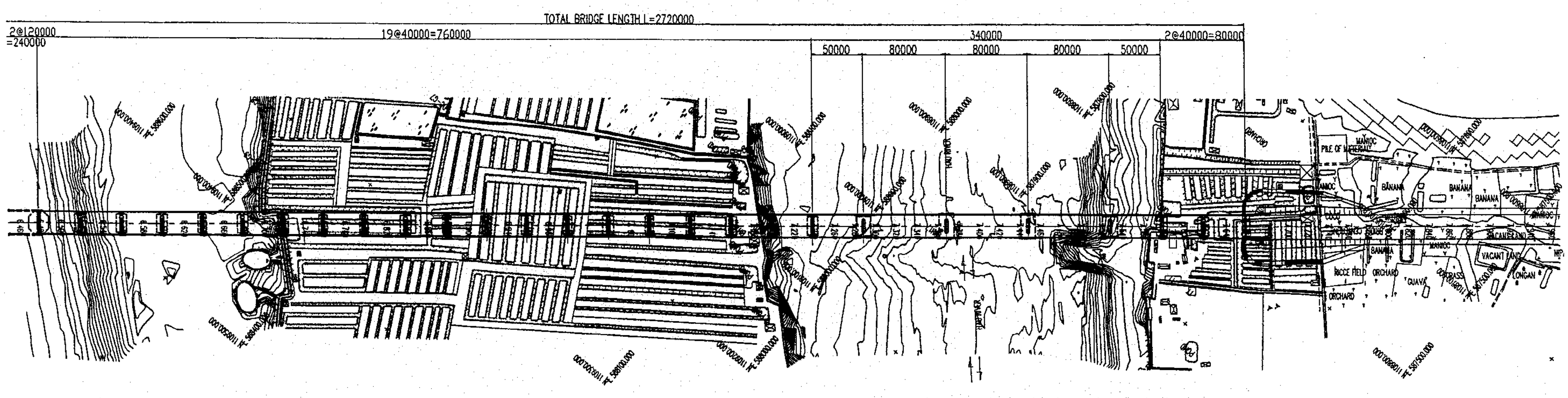
PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGENCY	JICA STUDY TEAM		PREPARED BY	CHECKED BY	APPROVED BY	DRAWING TITLE	DWG NO.
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF VIET NAM MINISTRY OF TRANSPORT (MOT) MY THUAN PROJECT MANAGEMENT UNIT	NIPPON KOEI CO.,LTD.	NAME				Figure 7.30 General View of Main Bridge (1/2)	7 - 51
				SIGNATURE					
				DATE					

GE

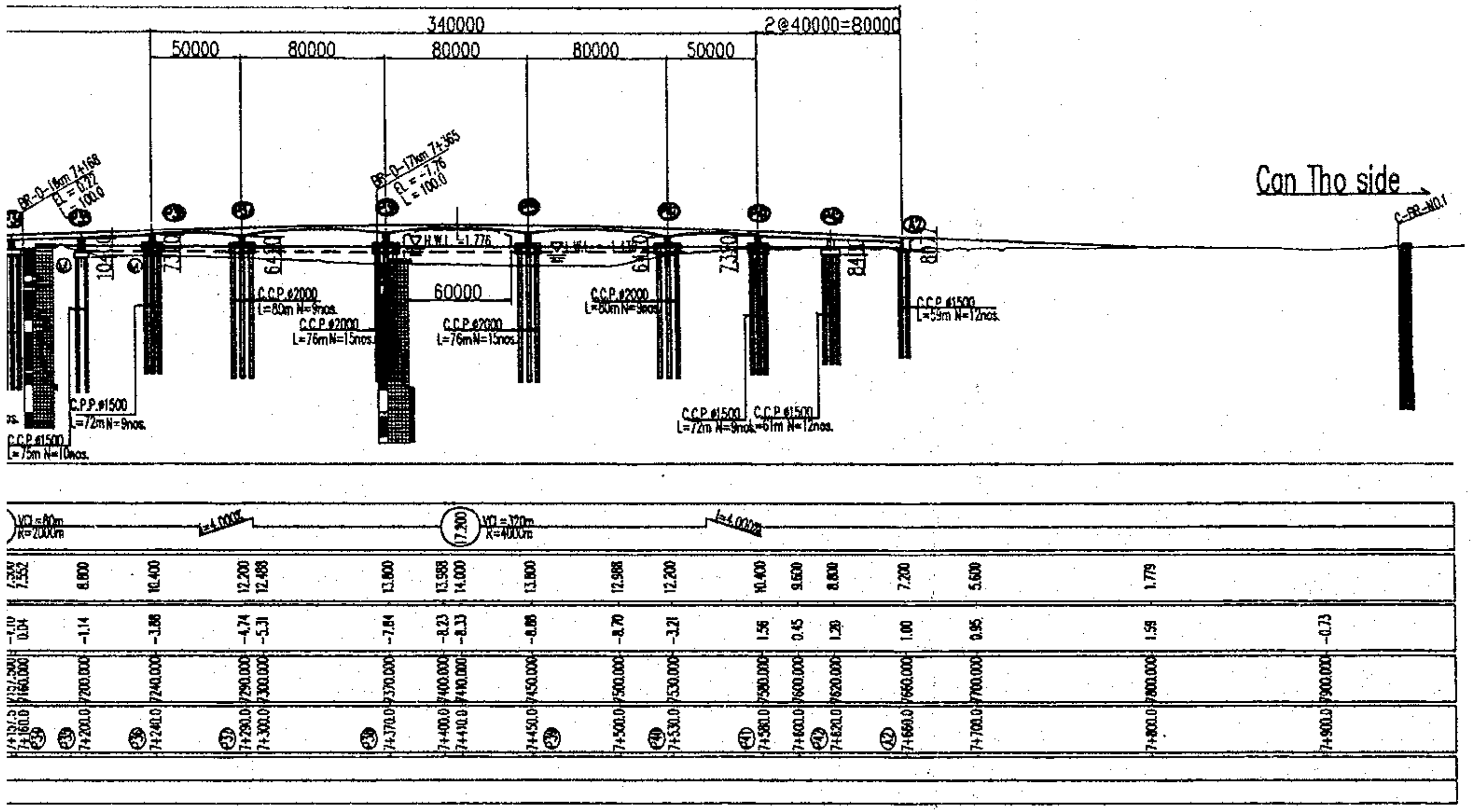
SIDE ELEVATION SCALE 1:4000

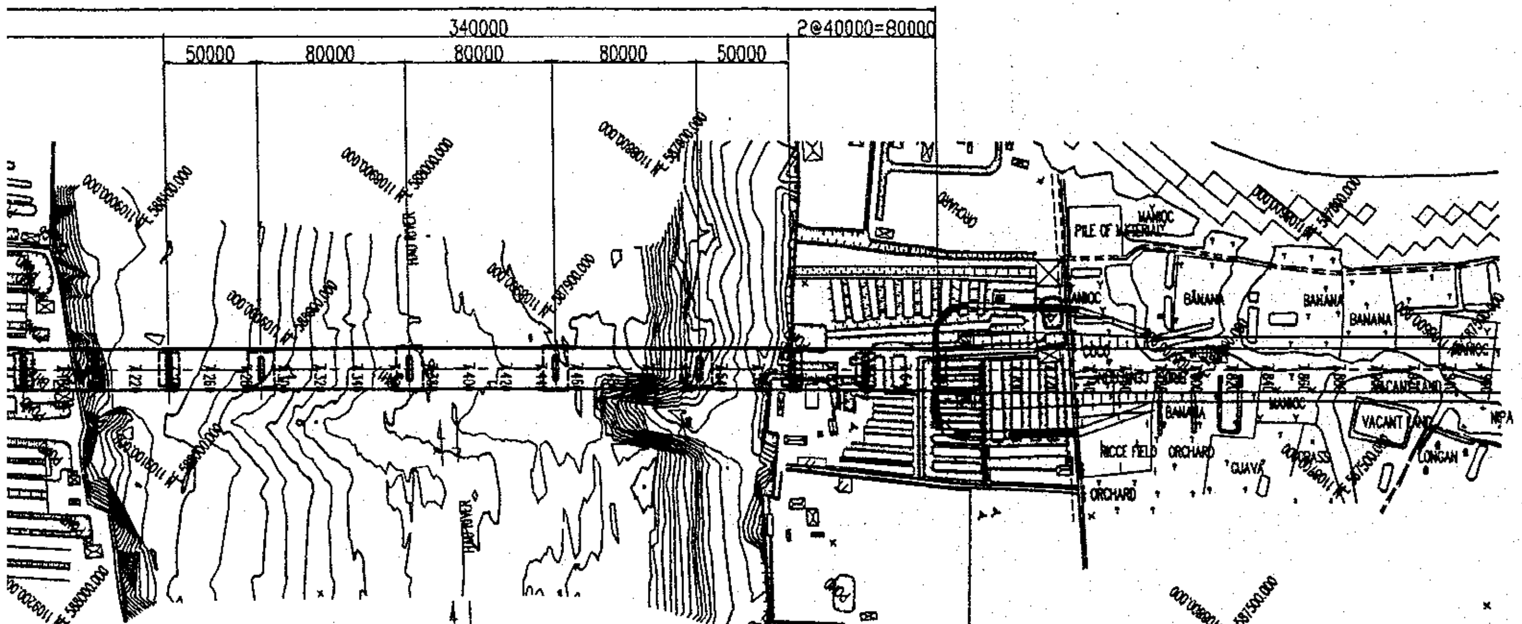


PLAN SCALE 1:2000



GENERAL VIEW (2/2)

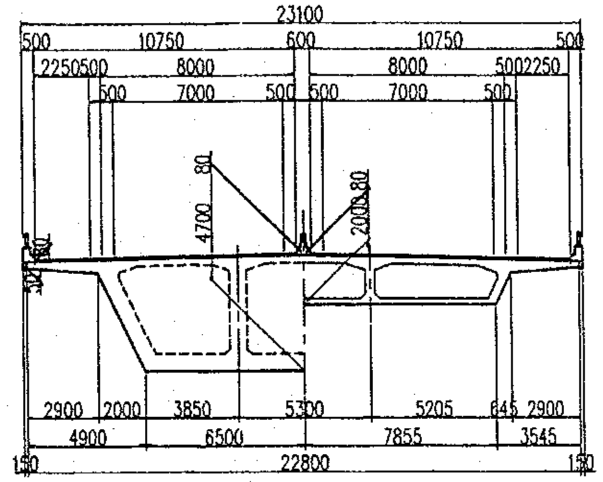




SUPERSTRUCTURE SCALE 1:300

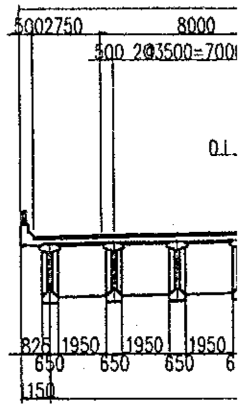
MAIN BRIDGE OF SUB-STREAM

PC BOX GIRDER

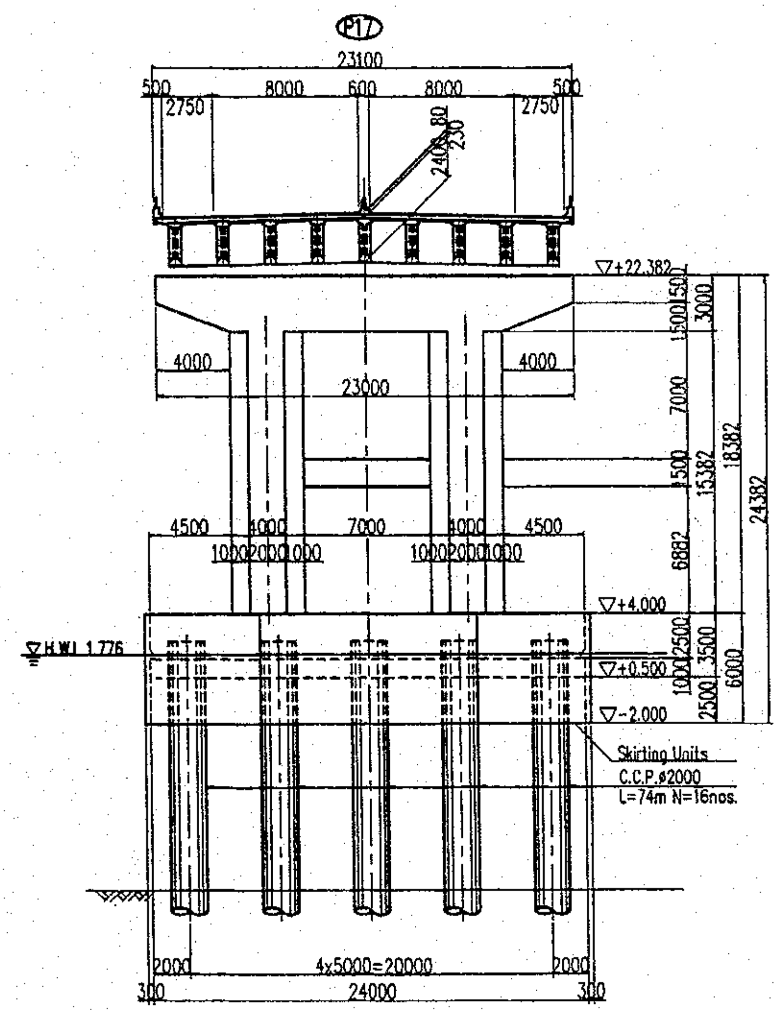


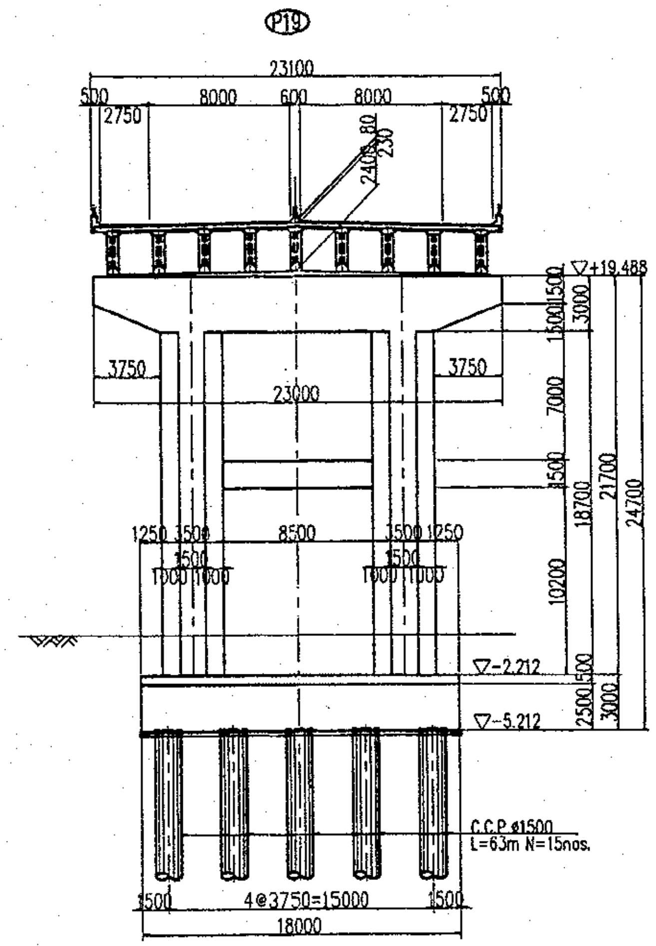
APPRO

PC



SUBSTRUCTURE



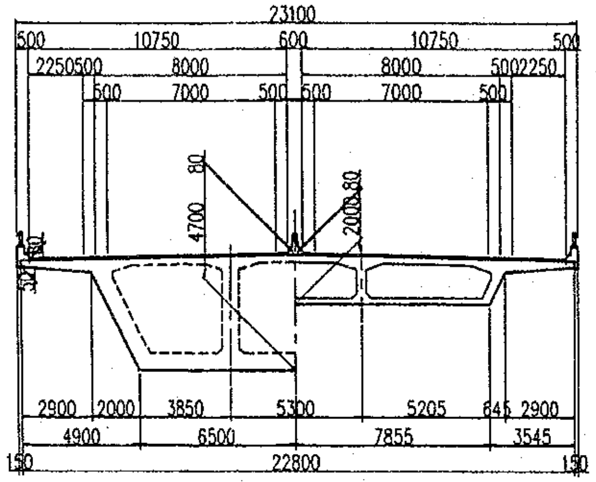


PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGENCY
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF VIET NAM MINISTRY OF TRANSPORT (MOT) MY THUAN PROJECT MANAGEMENT UNIT

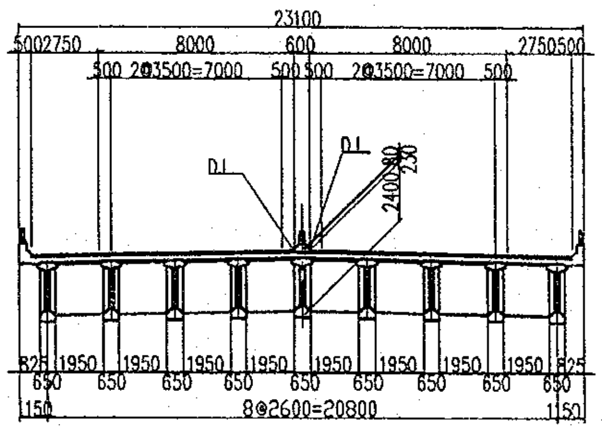
ERAL VIEW (2/2)

SUPERSTRUCTURE SCALE 1: 300

MAIN BRIDGE OF SUB-STREAM
PC BOX GIRDER



APPROACH BRIDGE
PC BOX GIRDER



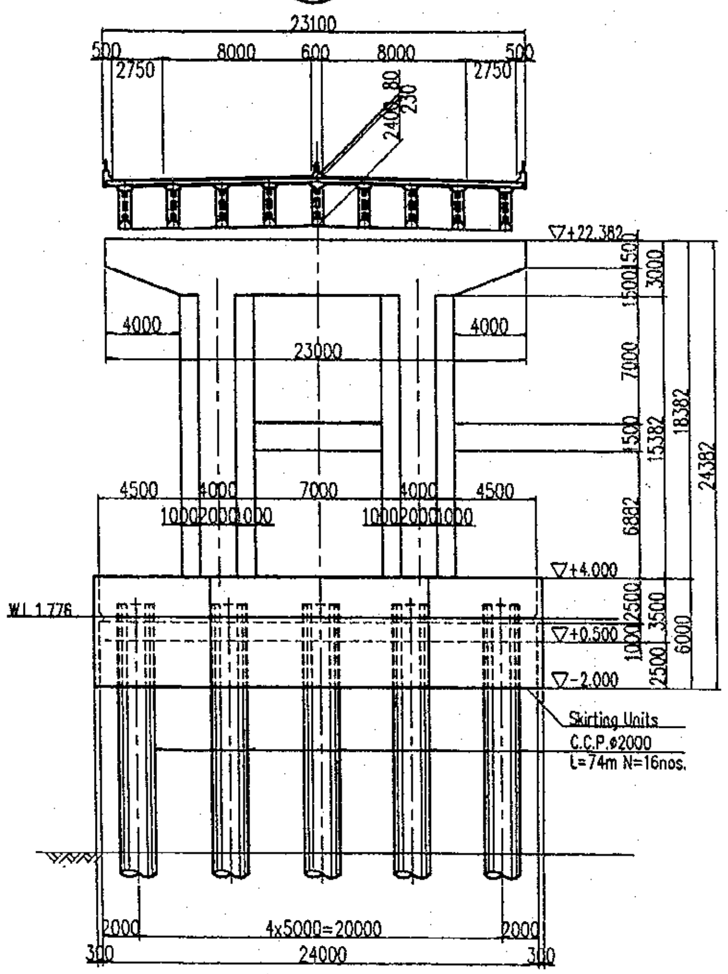
DESIGN CRITERIA

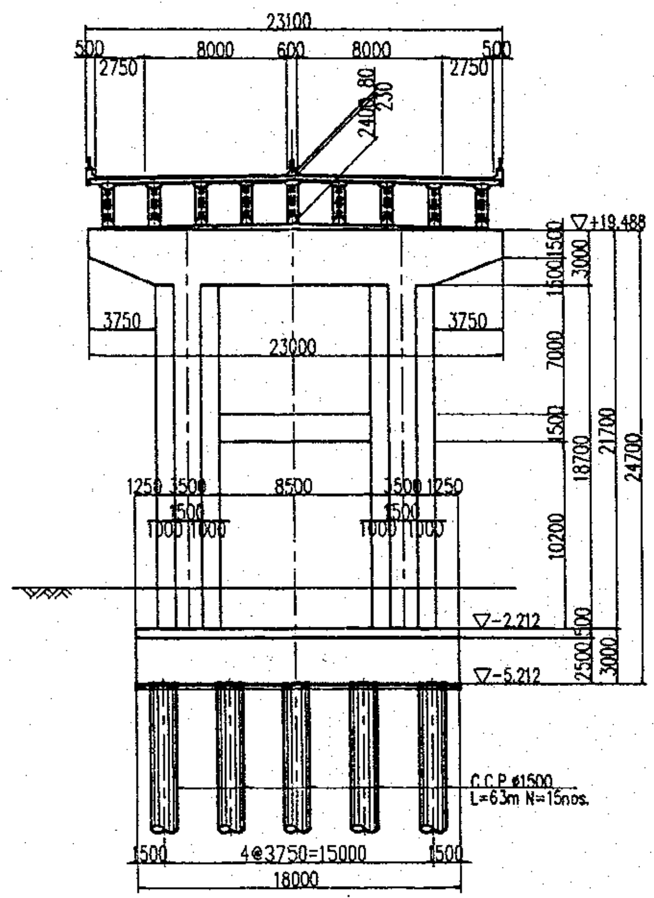
TYPE	HYBRID CABLE STAYED BRIDGE
TOTAL BRIDGE LENGTH	L=1090.000m
SPAN	2@70m+130m+550m+130m+2@70m
WIDTH	CARRIAGE WAY WIDTH=21.5m (10.75m+10.75m)
LIVE LOAD	B-LIVE LOAD
IMPACT COEFFICIENT	i=20/(L+50)
SEISMIC DATE	Kh=0.12
ANGLE OF SKEW	90° 00'00"
RADIUS OF CURVATURE	R=∞
LONGITUDINAL SLOPE	4.0% ⟋ ⟍ 4.0% V.C.L.=320m

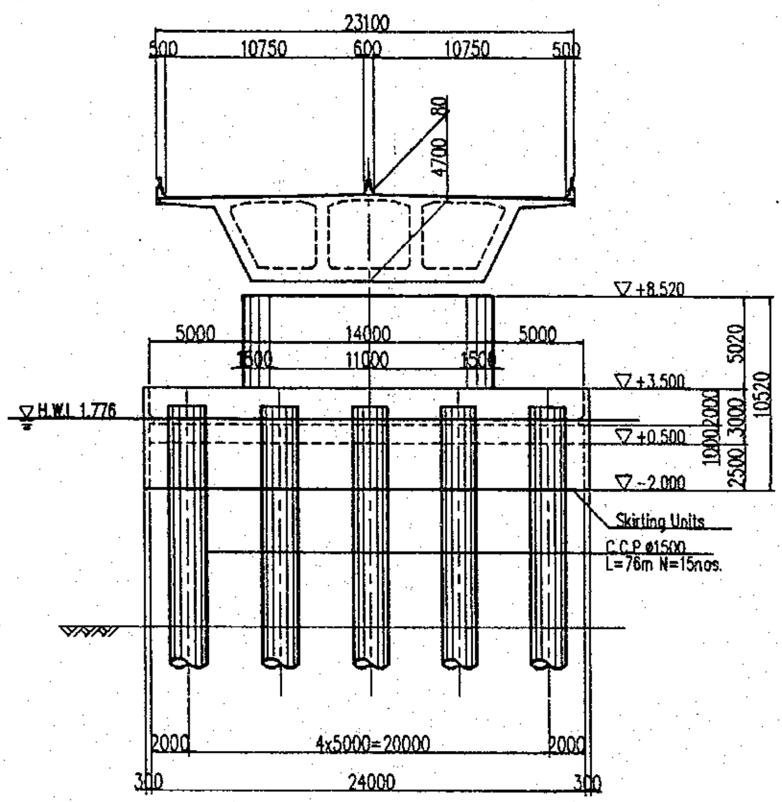
MATERIALS

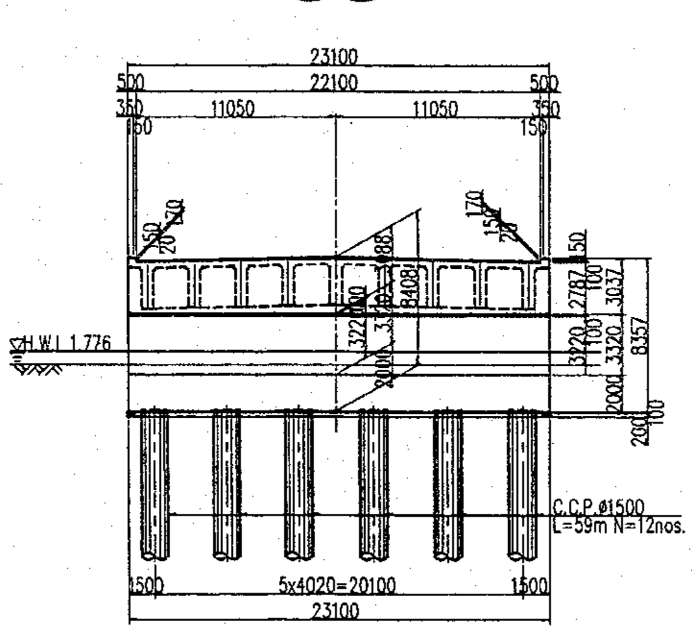
CONCRETE	GIRDER	σck=50MPa
	PYLON	σck=40MPa
	PILECAP OF PYLON	σck=30MPa
	SUBSTRUCTURE	σck=25MPa
	BORED PILE	σck=30MPa
PC STEEL	GIRDER	12S15.2B(SWPR7B),PC Bar Dia.32mm
	STAY CABLE	15.2B (SWPR7B)
STEEL	GIRDER	SS400,SMA400,SMA490

SUBSTRUCTURE SCALE 1: 400









PROJECT NAME	IMPLEMENTATION AGENCY	EXECUTING AGENCY	JICA STUDY TEAM		PREPARED BY	CHECKED BY	APPROVED BY	DRAWING TITLE	DWG NO.
DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION PROJECT	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	SOCIALIST REPUBLIC OF VIET NAM MINISTRY OF TRANSPORT (MOT) MY THUAN PROJECT MANAGEMENT UNIT	NIPPON KOEI CO.,LTD.	NAME	S. Kiguchi	K.Matsumoto	K. Enomoto	Figure 7.31 General View of Main Bridge (2/2)	7 - 52
				SIGNATURE	S. Kiguchi	K. Matsumoto	[signature]		
				DATE	20/9/2000	29/9/2000	5/10/2000		

7.4 Bridge Design for the Approach Road Sections

To control the design of the bridges for the approach road sections, the location of abutment, span length, span arrangement, location of riverbank and type of bridge structures were carefully studies and designed.

7.4.1 Location of Abutment

To determine the location of the abutment of bridges, the following conditions were considered:

(1) The maximum height of the abutment above the ground is 7.0m from the viewpoint of soft ground treatment and construction costs, described in Section 5.2.7.

(2) The following distance from the riverbank to the abutment should be maintained.

- L =25m, 6.0m< Abutment High (H) ≤ 7.0m
- L=20m, 5.0m < Abutment High (H) ≤ 6.0m
- L=15m Abutment High (H) ≤ 5.0m

7.4.2 Span Length and Arrangement

The span length and its arrangement between piers or pier and abutment of the bridge were determined based on the following conditions:

- The requirements from the navigational clearance of tributaries (canal and river) and the clearance for the people's passing across the road.
- The pier's location in the tributary should be as near as possible to the riverbank.
- To standardize the design and economize the construction cost, the girder lengths for PC-I girder are max 37m and 25, 28 and 31m, and the ratio of span length for the balanced cantilever PC-BOX varies from 1:1.5:1 to 1:1.6:1.

7.4.3 Location of the Riverbank

The location of the riverbank is not clear at the site and there are no exact rules or future plan at the place of bridge crossing. For the design of bridge the condition of natural riverbank was considered.

7.4.4 Flood Flow Direction and Skew of Tributaries for the Bridge

The direction of the bridge including the substructures should be along with the direction of the flood water (parallel with the flow direction of the Hau River), and keeping right angle for the bridge to the centerline alignment of the Project from the following reasons:

- Flood water flow in parallel with the direction of the Hau River.
- The bridge structures with skew angle will disturb the water flow under the bridges.
- Rotation of the bridge abutments will occur due to imbalance of soil pressure from the road embankment on the weak soil.
- Cost will be increased due to the structural reinforcement for the characteristic of skewed structures.
- Complicated structures will be required due to the sharp skew angle.

7.4.5 Type of Bridge Structures

- In case that the design penetration depth is shallower than 40m, Precast Reinforced Concrete (RC) pile with 450mm x 450mm was designed.
- In case that the design penetration depth is deeper than 40m, Bored Hole Pile with diameter 1.5m and 2.0m were designed. Because of the difficulty to install the pile vertically as designed, Bored Hole Piles with diameter less than 1.2m were rejected.
- In case of the required height above the ground is to be 7m, Inverted-T type of abutment was designed.
- For the PC-BOX and PRC-Hollow-Slab, the wall type of pier was designed.
- In case that the required span length is less than 37m, PC-I girder type was designed, while greater than 37m, PC-BOX girder was designed.

7.4.6 Minor Bridges

(1) Bridge Width

- Main Route	12.05m(up) + 12.05(down)	= 24.1m
- Interchange Bridge	(2-lane)	= 14.0m
- Interchange Bridge	(4-lane)	= 31.0m
- Interchange Bridge	(Rampway)	= 7.5m

(2) Vinh Long Side

a) Main Route

- PC - BOX (Balanced Cantilever)	:	130.0 m
- PC - I (Connection Girder)	:	169.1 m
- PC - I (Simple Span Girder)	:	130.0 m

b) Interchange

- PRC - Hollow Slab	:	132.7 m

c) Subtotal

- Main Route	:	629.1 m
- Interchange	:	132.7 m
- Total	:	761.8 m

(3) Can Tho Side

a) Main Route

- PC - BOX (Balanced Cantilever)	:	159.0 m
- PC - I (Connection Girder)	:	279.4 m
- PC - I (Simple Span Girder)	:	396.1 m

b) Interchange

- PRC - Hollow Slab	:	100.1 m
- PC - I (Connection Girder)	:	93.5 m

c) Subtotal

- Main Route	:	834.5 m
- Interchange	:	193.6 m
- Total	:	1,028.1 m

(4) Total

- Main Route Bridge Length	:	1,463.6 m
- Interchange Bridge Length	:	326.3 m
- Total Bridge Length	:	1,789.9 m

Table 7.36 Features of Minor Bridge (1/3)

Side	Bridge Name	Chainage	Direction	Bridge Length	Superstructure	Substructure		Abutment (A1)	Pier (P1)	Pier (P2)	Pier (P3)	Pier (P4)	Pier (P5)	Pier (P6)	Pier (P7)	Abutment (A2)
Vinh Long	Large Tra Va Bridge	0 + 578.55 ~ 0 + 860.15	HO CHI MINH ↓ CA MAU	281.60m	PC-I (Connect) 4 @ 35 + 4 @ 35 H=1.85m H=1.85m	Structural Height		9.2 m	9.4 m	8.9 m	10.4 m	9.4 m	5.8 m	5.3 m	8.9 m	9.2 m
						Fix/Mov		M	F,F	F,F	F,F	M,M	F,F	F,F	F,F	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Reversed-T-Type
						Water inside/Land		Land	Land	Land	Land	Land	Water inside	water inside	Land	Land
						Pile	BOR No.	D-1	D-1	D-1	D-1	D-1	D-2	D-3	D-3	D-3
							Bore hole pile	ϕ1.5m*70m*17nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*74m*12nos	ϕ1.5m*74m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*17nos
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	281.60m	PC-I (Connect) 4 @ 35 + 4 @ 35 H=1.85m H=1.85m	Structural Height			9.4 m	8.9 m	10.4 m	9.4 m	5.8 m	5.3 m	8.9 m	
						Fix/Mov			F,F	F,F	F,F	M,M	F,F	F,F	F,F	
						Type			Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	
						Water inside/Land			Land	Land	Land	Land	Water inside	water inside	Land	
						Pile	BOR No.		D-1	D-1	D-1	D-1	D-2	D-3	D-3	
							Bore hole pile		ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*70m*12nos	ϕ1.5m*74m*12nos	ϕ1.5m*74m*12nos	ϕ1.5m*70m*12nos	
							Driven pile		-	-	-	-	-	-	-	
	Small Tra Va Bridge	1 + 866.25 ~ 1 + 953.75	HO CHI MINH ↓ CA MAU	87.50m	PC-I (Connect) 25 + 37 + 25 H=1.45m H=1.85m H=1.45m	Structural Height		8.2 m	7.4 m	7.4 m	-	-	-	-	-	8.2 m
						Fix/Mov		M	F,F	F,F	-	-	-	-	-	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Land	-	-	-	-	-	Land
						Pile	BOR No.	D-5	D-5	D-6	-	-	-	-	-	D-6
							Bore hole pile	ϕ1.5m*66m*10nos	ϕ1.5m*64m*8nos	ϕ1.5m*64m*8nos	-	-	-	-	-	ϕ1.5m*66m*10nos
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	87.50m	PC-I (Connect) 25 + 37 + 25 H=1.45m H=1.85m H=1.45m	Structural Height			7.4 m	7.4 m	-	-	-	-	-	
						Fix/Mov			F,F	F,F	-	-	-	-	-	
						Type			Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	
						Water inside/Land			Land	Land	-	-	-	-	-	
						Pile	BOR No.		D-5	D-6	-	-	-	-	-	
							Bore hole pile		ϕ1.5m*64m*8nos	ϕ1.5m*64m*8nos	-	-	-	-	-	
							Driven pile		-	-	-	-	-	-	-	
	Tra On Bridge	3 + 582.00 ~ 3 + 842.00	HO CHI MINH ↓ CA MAU	260.00m	PC-I (Simple) 2@36.0 H=1.85m + PC-BOX 36.5+57+36.5 H=2.3~3.8m + PC-I (Simple) 2@28.6 H=1.85m	Structural Height		9.5 m	9.5 m	9.5 m	15.0 m	15.0 m	9.5 m	9.5 m	-	9.2 m
						Fix/Mov		M	F,F	F,M	F	F	M.F	F,F	-	M
						Type		Reversed-T-Type	Wall-Type(1)	Wall-Type(1)	Wall-Type(2)	Wall-Type(2)	Wall-Type(1)	Wall-Type(1)	-	Reversed-T-Type
						Water inside/Land		Land	Land	Land	Water inside	Water inside	Land	Land	-	Land
						Pile	BOR No.	D-8	D-8	D-8	D-8	D-9	D-9	D-9	-	D-9
							Bore hole pile	ϕ1.5m*79m*17nos	ϕ1.5m*77m*6nos	ϕ1.5m*77m*6nos	ϕ1.5m*71m*9nos	ϕ1.5m*71m*9nos	ϕ1.5m*77m*6nos	ϕ1.5m*77m*6nos	-	ϕ1.5m*79m*17nos
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	260.00m	PC-I (Simple) 2@31.6 H=1.85m + PC-BOX 36.5+57+36.5 H=2.3~3.8m + PC-I (Simple) 2@33.0 H=1.85m	Structural Height			9.5 m	9.5 m	15.0 m	15.0 m	9.5 m	9.5 m	-	
						Fix/Mov			F,F	F,M	F	F	M.F	F,F	-	
						Type			Wall-Type(1)	Wall-Type(1)	Wall-Type(2)	Wall-Type(2)	Wall-Type(1)	Wall-Type(1)	-	
						Water inside/Land			Land	Land	Water inside	Water inside	Land	Land	-	
						Pile	BOR No.		D-8	D-8	D-8	D-9	D-9	D-9	-	
							Bore hole pile		ϕ1.5m*77m*6nos	ϕ1.5m*77m*6nos	ϕ1.5m*71m*9nos	ϕ1.5m*71m*9nos	ϕ1.5m*77m*6nos	ϕ1.5m*77m*6nos	-	
							Driven pile		-	-	-	-	-	-	-	
	Interchange (NH.54) Over Bridge	3 + 129.68	CAI VON TOWN ↓↑ TRA ON TOWN	132.70m	PRC-Hollow Slab 2 @ 24.5 + 34.5 + 2 @ 24.5 H=1.25~2.00m	Structural Height		8.8 m	8.5 m	8.1 m	8.1 m	8.5 m	-	-	-	8.8 m
						Fix/Mov		M	M	R	R	M	-	-	-	M
						Type		Reversed-T-Type	Wall-Type(3)	Wall-Type(3)	Wall-Type(3)	Wall-Type(3)	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Land	Land	Land	-	-	-	Land
						Pile	BOR No.	D-7	D-7	D-7	D-7	D-7	-	-	-	D-7
							Bore hole pile	ϕ1.5m*71m*8nos	ϕ1.5m*75m*4nos	ϕ1.5m*75m*6nos	ϕ1.5m*75m*6nos	ϕ1.5m*75m*4nos	-	-	-	ϕ1.5m*71m*8nos
							Driven pile	-	-	-	-	-	-	-	-	-

Table 7.37 Features of Minor Bridge (2/3)

Side	Bridge Name	Chainage	Direction	Bridge Length	Superstructure	Substructure		Abutment (A1)	Pier (P1)	Pier (P2)	Pier (P3)	Pier (P4)	Pier (P5)	Pier (P6)	Pier (P7)	Abutment (A2)
Can Tho	Cai Tac 1 Bridge	8 + 456.85 ~ 8 + 642.75	HO CHI MINH ↓ CA MAU	185.90m	PC-I (Connect) 5@37 H=1.85m	Structural Height		7.6 m	8.4 m	8.0 m	9.0 m	9.0 m	-	-	-	9.2 m
						Fix/Mov		M	M,M	F,F	F,F	M,M	-	-	-	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Land	Water inside	Water inside	-	-	-	Land
						Pile	BOR No.	D-18	D-18	D-18	D-19	D-19	-	-	-	D-19
							Bore hole pile	φ1.5m*51m*10nos	φ1.5m*49m*10nos	φ1.5m*53m*10nos	φ1.5m*53m*10nos	φ1.5m*53m*10nos	-	-	-	φ1.5m*55m*12m
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	185.90m	PC-I (Connect) 5@37 H=1.85m	Structural Height			8.4 m	8.0 m	9.0 m	9.0 m	-	-	-	
						Fix/Mov			M,M	F,F	F,F	M,M	-	-	-	
						Type			Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	
						Water inside/Land			Land	Land	Water inside	Water inside	-	-	-	
						Pile	BOR No.		D-18	D-18	D-19	D-19	-	-	-	
							Bore hole pile		φ1.5m*49m*10nos	φ1.5m*53m*10nos	φ1.5m*53m*10nos	φ1.5m*53m*10nos	-	-	-	
							Driven pile		-	-	-	-	-	-	-	
	Cai Tac 2 Bridge	9 + 431.45 ~ 9 + 468.55	HO CHI MINH ↓ CA MAU	37.10m	PC-I (Simple) 37 H=1.85m	Structural Height		7.9 m	-	-	-	-	-	-	-	7.9 m
						Fix/Mov		F	-	-	-	-	-	-	-	M
						Type		Reversed-T-Type	-	-	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	-	-	-	-	-	-	-	Land
						Pile	BOR No.	D-20	-	-	-	-	-	-	-	D-20
							Bore hole pile	φ1.5m*55m*14nos	-	-	-	-	-	-	-	φ1.5 m*55m*12nos
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	37.10m	PC-I (Simple) 37 H=1.85m (W=18.25m)	Structural Height			-	-	-	-	-	-	-	
						Fix/Mov			-	-	-	-	-	-	-	
						Type			-	-	-	-	-	-	-	
						Water inside/Land			-	-	-	-	-	-	-	
						Pile	BOR No.		-	-	-	-	-	-	-	
							Bore hole pile		-	-	-	-	-	-	-	
							Driven pile		-	-	-	-	-	-	-	
	Cai Da Bridge	10 + 416.25 ~ 10 + 509.75	HO CHI MINH ↓ CA MAU	93.50m	PC-I (Connect) 28 + 37 + 28 H=1.65m H=1.85m H=1.65m	Structural Height		7.5 m	9.1 m	9.1 m	-	-	-	-	-	7.5 m
						Fix/Mov		M	F,F	F,F	-	-	-	-	-	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Water inside	Water inside	-	-	-	-	-	Land
						Pile	BOR No.	D-21	D-21	D-21	-	-	-	-	-	D-21
							Bore hole pile	φ1.5m*55m*10nos	φ1.5m*52m*4nos	φ1.5m*52m*4nos	-	-	-	-	-	φ1.5m*55m*10nos
							Driven pile	-	-	-	-	-	-	-	-	-
			CA MAU ↓ HO CHI MINH	93.50m	PC-I (Connect) 28 + 37 + 28 H=1.65m H=1.85m H=1.65m	Structural Height			9.1 m	9.1 m	-	-	-	-	-	
						Fix/Mov			F,F	F,F	-	-	-	-	-	
						Type			Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	
						Water inside/Land			Water inside	Water inside	-	-	-	-	-	
						Pile	BOR No.		D-21	D-21	-	-	-	-	-	
							Bore hole pile		φ1.5m*52m*4nos	φ1.5m*52m*4nos	-	-	-	-	-	
							Driven pile		-	-	-	-	-	-	-	
	Ba Mang Bridge	11 + 202.45 ~ 11 + 227.55	HO CHI MINH ↓ CA MAU	25.10m	PC-I (Simple) 25 H=1.45m	Structural Height		7.8 m	-	-	-	-	-	-	-	7.8 m
						Fix/Mov		F	-	-	-	-	-	-	-	M
						Type		Reversed-T-Type	-	-	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	-	-	-	-	-	-	-	Land
						Pile	BOR No.	D-22	-	-	-	-	-	-	-	D-22
							Bore hole pile	-	-	-	-	-	-	-	-	-
							Driven pile	450*450*40m*78nos	-	-	-	-	-	-	-	450*450*40m*78nos
			CA MAU ↓ HO CHI MINH	25.10m	PC-I (Simple) 25 H=1.45m	Structural Height			-	-	-	-	-	-	-	
						Fix/Mov			-	-	-	-	-	-	-	
						Type			-	-	-	-	-	-	-	
						Water inside/Land			-	-	-	-	-	-	-	
						Pile	BOR No.		-	-	-	-	-	-	-	
							Bore hole pile		-	-	-	-	-	-	-	
							Driven pile		-	-	-	-	-	-	-	

Table 7.38 Features of Minor Bridge (3/3)

Side	Bridge Name	Chainage	Direction	Bridge Length	Superstructure	Substructure										
								Abutment (A1)	Pier (P1)	Pier (P2)	Pier (P3)	Pier (P4)	Pier (P5)	Pier (P6)		Abutment (A2)
Can Tho	Cai Nai Bridge	12 + 336.25 ~ 12 + 429.75	HO CHI MINH ↓ CA MAU	93.50m	PC-I (Simple) 28 + 37 + 28 H=1.65m H=1.85m H=1.65m	Structural Height		8.2 m	10.8 m	10.8 m	-	-	-	-	-	8.2 m
						Fix/Mov		M	F,F	F,F	-	-	-	-	-	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Water inside	Water inside	-	-	-	-	-	Land
						Pile	BOR No.	D-23	D-23	D-24	-	-	-	-	-	D-24
							Bore hole pile	-	-	-	-	-	-	-	-	-
							Driven pile	450*450*40m*78nos	450*450*40m*24nos	450*450*40m*24nos	-	-	-	-	-	450*450*40m*78nos
			CA MAU ↓ HO CHI MINH	93.50m	PC-I (Simple) 28 + 37 + 28 H=1.65m H=1.85m H=1.65m	Structural Height			10.8 m	10.8 m	-	-	-	-	-	
						Fix/Mov			F,F	F,F	-	-	-	-	-	
						Type			Multi-Column-Type	Multi-Column-Type	-	-	-	-	-	
						Water inside/Land			Water inside	Water inside	-	-	-	-	-	
						Pile	BOR No.		D-23	D-24	-	-	-	-	-	
							Bore hole pile		-	1.5 m	-	-	-	-	-	
							Driven pile		450*450*40m*24nos	450*450*40m*24nos	-	-	-	-	-	
	Ap My Bridge	13 + 109.55 ~ 13 + 250.45	HO CHI MINH ↓ CA MAU	140.90m	PC-I (Simple) 28 + 25 + 37 + 25 + 25 H=1.65m, 1.45m H=1.85m H=1.45m, 1.65m	Structural Height		9.2 m	7.7 m	11.5 m	11.5 m	7.7 m	-	-	-	9.2 m
						Fix/Mov		M	M,M	F,F	F,F	M,M	-	-	-	M
						Type		Reversed-T-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Water inside	Water inside	Land	-	-	-	Land
						Pile	BOR No.	D-26	D-26	D-26	D-26	D-26	-	-	-	D-26
							Bore hole pile	-	-	-	-	-	-	-	-	-
							Driven pile	450*450*40m*90nos	450*450*40m*24nos	450*450*40m*24nos	450*450*40m*24nos	450*450*40m*24nos	-	-	-	450*450*40m*90nos
			CA MAU ↓ HO CHI MINH	140.90m	PC-I (Simple) 25 + 25 + 37 + 25 + 28 H=1.65m, 1.45m H=1.85m H=1.45m, 1.65m	Structural Height			7.7 m	11.5 m	11.5 m	7.7 m	-	-	-	
						Fix/Mov			M,M	F,F	F,F	M,M	-	-	-	
						Type			Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	Multi-Column-Type	-	-	-	
						Water inside/Land			Land	Water inside	Water inside	Land	-	-	-	
						Pile	BOR No.		D-26	D-26	D-26	D-26	-	-	-	
							Bore hole pile		-	-	-	-	-	-	-	
							Driven pile		450*450*40m*24nos	450*450*40m*24nos	450*450*40m*24nos	450*450*40m*24nos	-	-	-	
	Cai Rang Bridge	13 + 806.40 ~ 14 + 64.90	HO CHI MINH ↓ CA MAU	258.50m	PC-I (Simple) 31 + / PC-BOX 42+75+42 + / PC-I (Simple) 37+31 H=1.85m H=2.2~4.4m H=1.85m	Structural Height		9.2 m	8.6 m	11.2 m	11.2 m	8.6 m	8.7 m	-	-	9.2 m
						Fix/Mov		M	F,M	F	F	M,F	F,F	-	-	M
						Type		Reversed-T-Type	Wall-Type(1)	Wall-Type(2)	Wall-Type(2)	Wall-Type(1)	Multi-Column-Type	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Water inside	Water inside	Land	Land	-	-	Land
						Pile	BOR No.	D-27	D-27	D-27	D-28	D-28	D-28	-	-	D-28
							Bore hole pile	-	ϕ1.5m*50m*4nos	ϕ1.5m*49m*9nos	ϕ1.5m*49m*9nos	ϕ1.5m*45m*4nos	-	-	-	-
							Driven pile	450*450*40m*90nos	-	-	-	-	450*450*40m*30nos	-	-	450*450*40m*90nos
			CA MAU ↓ HO CHI MINH	258.50m	PC-I (Simple) 37 / PC-BOX 42+75+42 + / PC-I (Simple) 31+31 H=1.85m H=2.2~4.4m H=1.85m	Structural Height			8.6 m	11.2 m	11.2 m	8.6 m	8.7 m	-	-	
						Fix/Mov			F,M	F	F	M,F	F,F	-	-	
						Type			Wall-Type(1)	Wall-Type(2)	Wall-Type(2)	Wall-Type(1)	Multi-Column-Type	-	-	
						Water inside/Land			Land	Water inside	Water inside	Land	Land	-	-	
						Pile	BOR No.		D-27	D-27	D-28	D-28	D-28	-	-	
							Bore hole pile		ϕ1.5m*50m*4nos	ϕ1.5m*49m*9nos	ϕ1.5m*49m*9nos	ϕ1.5m*45m*4nos	-	-	-	
							Driven pile		-	-	-	-	450*450*40m*30nos	-	-	
	Interchange (NH.91B) Over Bridge	-	CAN THO CITY ↓↑ CA CUI POT	100.10m	PRC-Hollow Slab 4 @ 25 H=1.25m	Structural Height		9.2 m	9.0 m	9.1 m	9.0 m	-	-	-	-	9.2 m
						Fix/Mov		M	R	M	R	-	-	-	-	M
						Type		Reversed-T-Type	Wall-Type(3)	Wall-Type(3)	Wall-Type(3)	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Land	Land	Land	-	-	-	-	Land
						Pile	BOR No.	D-21	D-21	D-21	D-21	-	-	-	-	D-21
							Bore hole pile	ϕ1.5m*57m*20nos	ϕ1.5m*57m*12nos	ϕ1.5m*57m*10nos	ϕ1.5m*57m*12nos	-	-	-	-	ϕ1.5m*57m*20nos
							Driven pile	-	-	-	-	-	-	-	-	-
				100.10m	PRC-Hollow Slab 4 @ 25 H=1.25m	Structural Height			9.0 m	9.1 m	9.0 m	-	-	-	-	
						Fix/Mov			R	M	R	-	-	-	-	
						Type			Wall-Type(3)	Wall-Type(3)	Wall-Type(3)	-	-	-	-	
						Water inside/Land			Land	Land	Land	-	-	-	-	
						Pile	BOR No.		D-21	D-21	D-21	-	-	-	-	
							Bore hole pile		ϕ1.5m*57m*12nos	ϕ1.5m*57m*10nos	ϕ1.5m*57m*12nos	-	-	-	-	
							Driven pile		-	-	-	-	-	-	-	
	Interchange (NH.91B) Ramp Way Bridge	—	Rampway D	93.50m	PC-I (Simple) 28 + 37 + 28 H=1.65m H=1.85m H=1.65m	Structural Height		7.6 m	9.2 m	9.2 m	-	-	-	-	-	7.6 m
						Fix/Mov		M	F,F	F,F	-	-	-	-	-	M
						Type		Reversed-T-Type	Wall-Type(1)	Wall-Type(1)	-	-	-	-	-	Reversed-T-Type
						Water inside/Land		Land	Water inside	Water inside	-	-	-	-	-	Land
						Pile	BOR No.	D-21	D-21	D-21	-	-	-	-	-	D-21
							Bore hole pile	-	-	-	-	-	-	-	-	-
							Driven pile	450*450*40m*24nos	450*450*40m*25nos	450*450*40m*25nos	-	-	-	-	-	450*450*40m*24nos