7.5 Design of Drainage System and Lighting Facilities

7.5.1 Drainage System on Bridge

(1) General

This Project plans to construct Hybrid Cable-stayed bridge and approach bridge for the main and other bridges and box culverts in several places on the project route. The drainage of this construction is planned in consideration of rainfall data and environmental condition.

Project area is mainly located in rivers, waterways, and agricultural area. Drainage method in this area is to drop water directly without installing drainpipes which require maintenance.

Drainage systems are designed with drain interval based on rainfall intensity and capacity of drain, and the features of drainage system are shown in Figure 7.32.

- In case of vertical alignment sagging, it allows for drain at the center and both side (within 3~5m) of the sag point.
- In case of cross incline near changing point of mitigation curve or s-curve being level or nearly level, it allows for drain at both sides of carriage way.
- It allows for drain of the upper side of expansion.

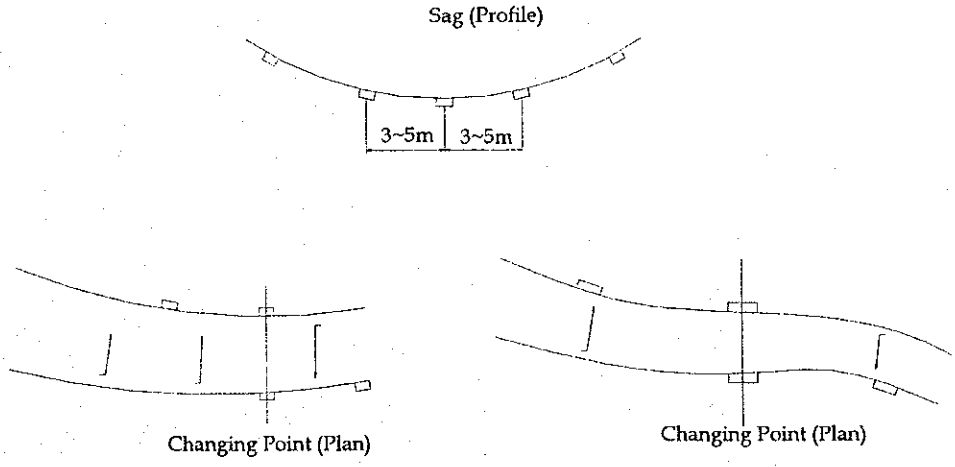


Figure 7.32 Drainage Arrangement

(2) Rainfall intensity

The rainy season of Project area is from November to May. This season is characterized by having 90% of the annual precipitation with 15-20 rainy days per month.

Rainfall intensity for drainage design is based on all precipitation per day for safety supposing that precipitation per day is equal to per hour in consideration of rain concentrated for a short time in a day (See Table 7.39).

Table 7.39 Rainfall Data

Year	Total of Rainfall (mm)	Daily maximum rainfall (mm)	Data	Number of rainy day
1978	1739.8	91.2	20-Nov	153
1979	1479.2	48.4	2-Sep	157
1980	1688.9	90.4	9-Jun	140
1981	1630.0	69.7	11-May	142
1982	1720.2	83.6	28-Sep	163
1983	1799.3	117.8	16-Sep	155
1985	1648.0	77.5	4-Jun	169
1986	1831.5	116.4	2-Nov	152
1987	1465,5	67.3	7-Oct	153
1988	1716.9	73.4	22-Oct	157
1989	1336.8	82.2	15-Jul	152
1990	1160.2	67.3	4-Aug	134
1991	1516.3	64.0	30-Jun	148
1992	1300.8	67.2	28-Jul	145
1995	1704.3	131.8	18-Jun	157
1996	2134.6	112.0	15-May	185
1997	1700.1	94.6	2-Nov	143
1998	1952.0	104.8	24-Oct	149

(3) Drainage section

Transverse cross section of Hybrid Cable-stayed bridge for the main span and approach span bridge is composed of 2-carriage way (3-carriage way in future) for one side shown in Figure 7.33.

For the design of drainage for the bridge deck, the width of 2.75m including shoulder is considered as flow section in consideration of the driving course of vehicle. And it covers the width of 11.05m for one side.

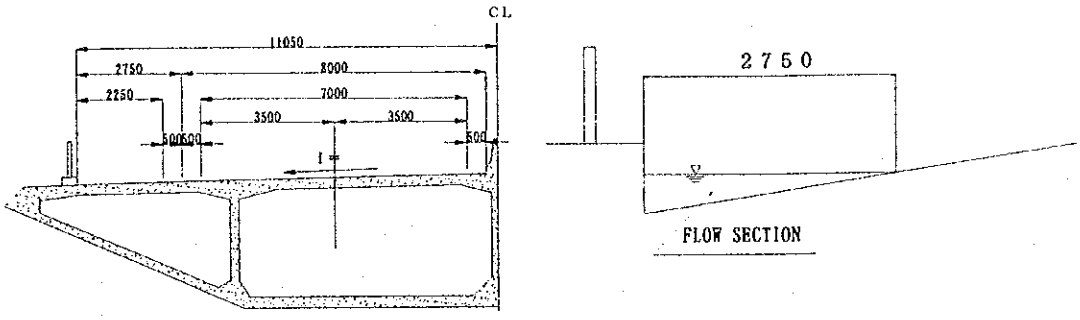


Figure 7.33 Drainage System of Cross Section

(4) Drainage interval

Drainage interval of each section on the bridge for rainfall intensity are shown in Figure 7.34.

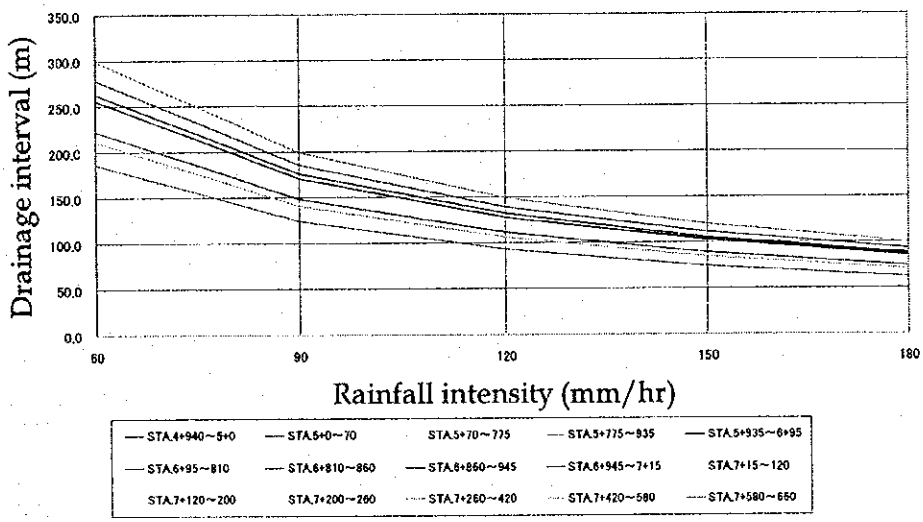


Figure 7.34 Rainfall Intensity and Drainage Interval

Rainfall intensity per day is 100mm/hr in the rainy season and a maximum 130mm/hr in this Project area. Theoretically, drainage interval of 80m is enough to drain but an interval of 10~20m was designed in consideration of bridge structure characteristic.

7.5.2 Navigation Light and Obstruction Light

The navigable lighting systems are planned for airplanes and ships at the time of during and after construction.

The navigation light establishes the following institution to the ship.

(1) Center light (green immovable light) and side edge light (red

immovable light) in order that the position of the route is displayed.

(2) Footlights lighting in order to indicate the position of the tower.

The obstruction light establishes the support institution to the airplane in nighttime and daytime. A red flickering light is established at the time of construction and white radiation light is established after construction (See Figure 7.35, Table 7.40 and Table 7.41).

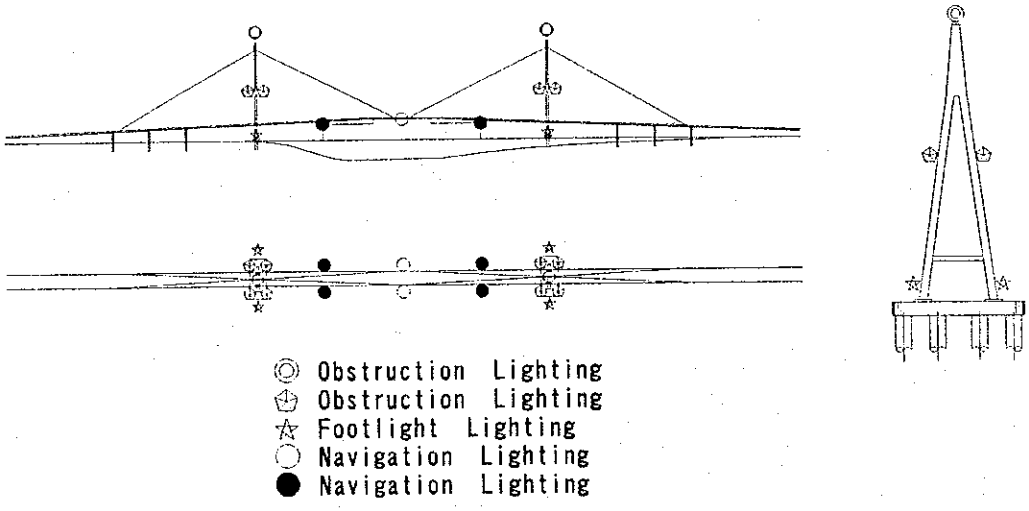


Figure 7.35 Establishment Position and Standard

Table 7.40 Aviation Obstacle Light Standard

Item	Standard		High intensity obstruction light FX-7S-200K
Light axis luminous intensity	Daytime (H)		200,000cd
	Twilight (M)		20,000cd+25%
	Nighttime (L)		4,000cd+25%
Beam angle	Level Vertical	120°	H-100,000cd
		3~7°	M-8,000cd
			L-1,500cd
Flash number			40 times/m ± 5%
Flash method			All amount in a bundle synchronous
Angle of elevation adjustment range			0~+8°

Table 7.41 Navigation Light Standard

		Center Light	Side Light
Form		500W shield beam lamp	
Arrangement		2 lines×5 steps, 10 lamps	
Grade and quality		Immovable green light	Immovable red light
Luminous intensity	Twilight	2000cd	2700cd
	Nighttime	40cd	100cd
Light distance		5.0 nautical miles	7.0 nautical miles

7.5.3 Lightning Rod

Lightning rod is established to prevent lightning striking the top of tower.

(1) Prevention range of lightning damage is in the circumference of 60 degree on the top of lightning rod. Length of lightning rod (H) is decided based on the shape and size of tower.

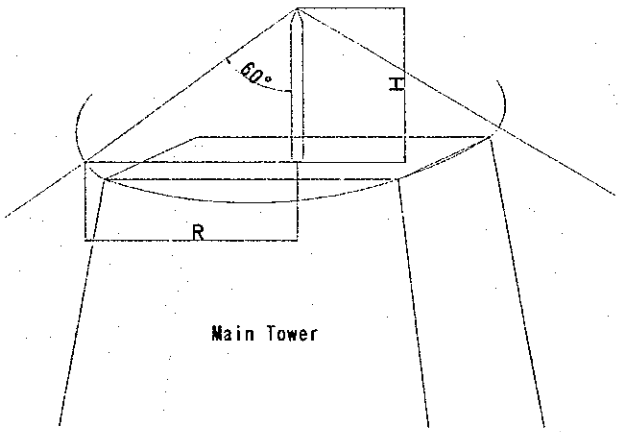


Figure 7.36 Prevention Range of Lighting Rod

(2) Leading wire leads to underground through reinforcing bar inside tower.

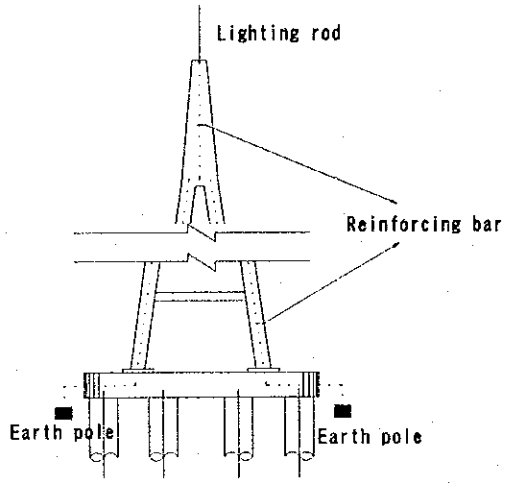


Figure 7.37 Reinforcing Bar

(3) The requirement for the stability of the rod against the wind load was studied.

7.6 Design of Infrastructure and Facilities

The detailed design of infrastructure and facilities was conducted mainly based on the discussions with People's Committee of Can Tho province and People's Committee of Vinh Long province, and other related authorities and organizations. The notice and publication listed below were referred to and applied to the design.

In addition to these conditions, the results of the interview survey from the residents in the Project areas conducted in November 1999, were considered. The number of households willing to move to the Resettlement Areas (R.A.) is basis of design condition for each R.A., as shown in Table 7.42. The location map and plan are shown in Figure 7.38, Figure 7.39, Figure 7.40 and Figure 7.41.

- The Resettlement Area of Hung Phu Ward followed the Can Tho City Master Plan which were approved by Prime Minister.

- Notice of Decision No.1747/1998-CT.KT dated 23rd July 1998 of a Planning Detail for Master Plan at Hung Phu Ward residential area on Can Tho City based on Decision no. 606/TTg 20th December 1993 was issued by Prime Minister and Decision No. 3236/QD.UBT 97 dated 16th December 1997 was issued by People Committee of Can Tho Province.

- Notice Decision No. 592/QD-GTVT dated 11th March 1999 was issued by MOT 1998 regarding land acquisition procedures and regulation.
- Minutes of Meeting dated 4th and 5th October 1999.
- Standard Construction of Viet Nam, Ministry of Construction (MOC) Decision No. 682/BXD-CSXD dated 14th December 1986 was issued by Minister of MOC.
- Viet Nam Highway Design Standards (TCVN 4054-98).
- Our letter Ref No. FKOCO/001/2000 dated 4th January 2000, the Technical Parameter of the Resettlement Area.
- Our Letter Ref No. FKOCO/059/99 dated 2nd November 1999 Minutes of Meeting.

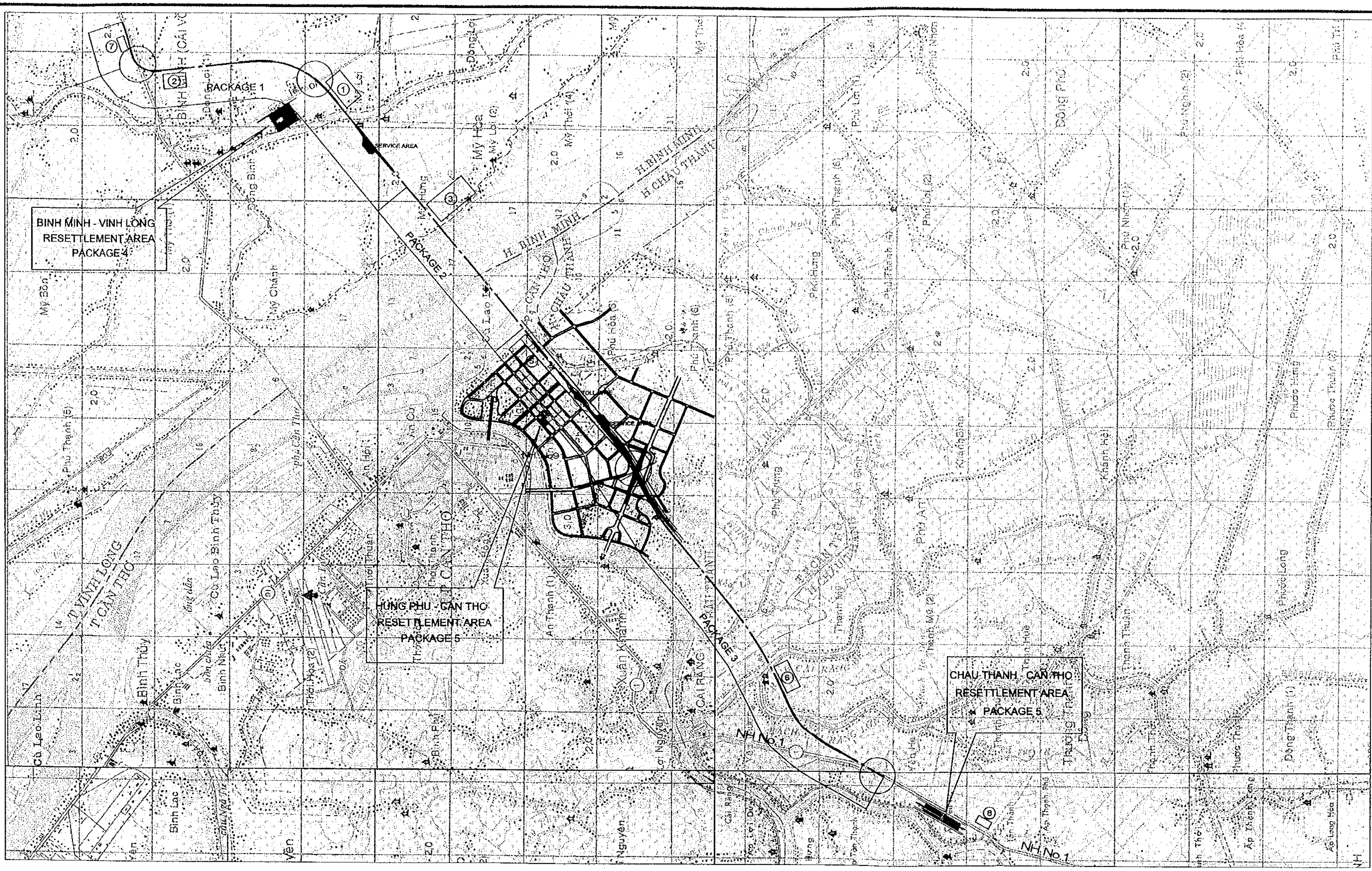
Table 7.42 Design Condition for Resettlement Areas (R.A.)

Description	Binh Minh R.A.	Hung Phu R.A	Chau Thanh R.A
Number of Households	149	22	57
Number of land lots	149	22	57
Average Area of each lot	250m2	126m2	200m2
Total Area	60,645m2	10,815m2	21,250m2
Public Const. Toilet and W.T.P*	Toilet - 3W.T.P	W.T.P	Toilet - 2W.T.P
Access Road	1 x 3.5	1 x 3.5	1 x 3.5
Bicycle lane	2 x 1.75	2 x 1.75	2 x 1.75
Inner Road	1 x 3.5		1 x 3.5
	2 x 1.25		2 x 1.25
Sidewalk and Shoulder	2.00 or 2.75	5.00	2.00 or 2.75

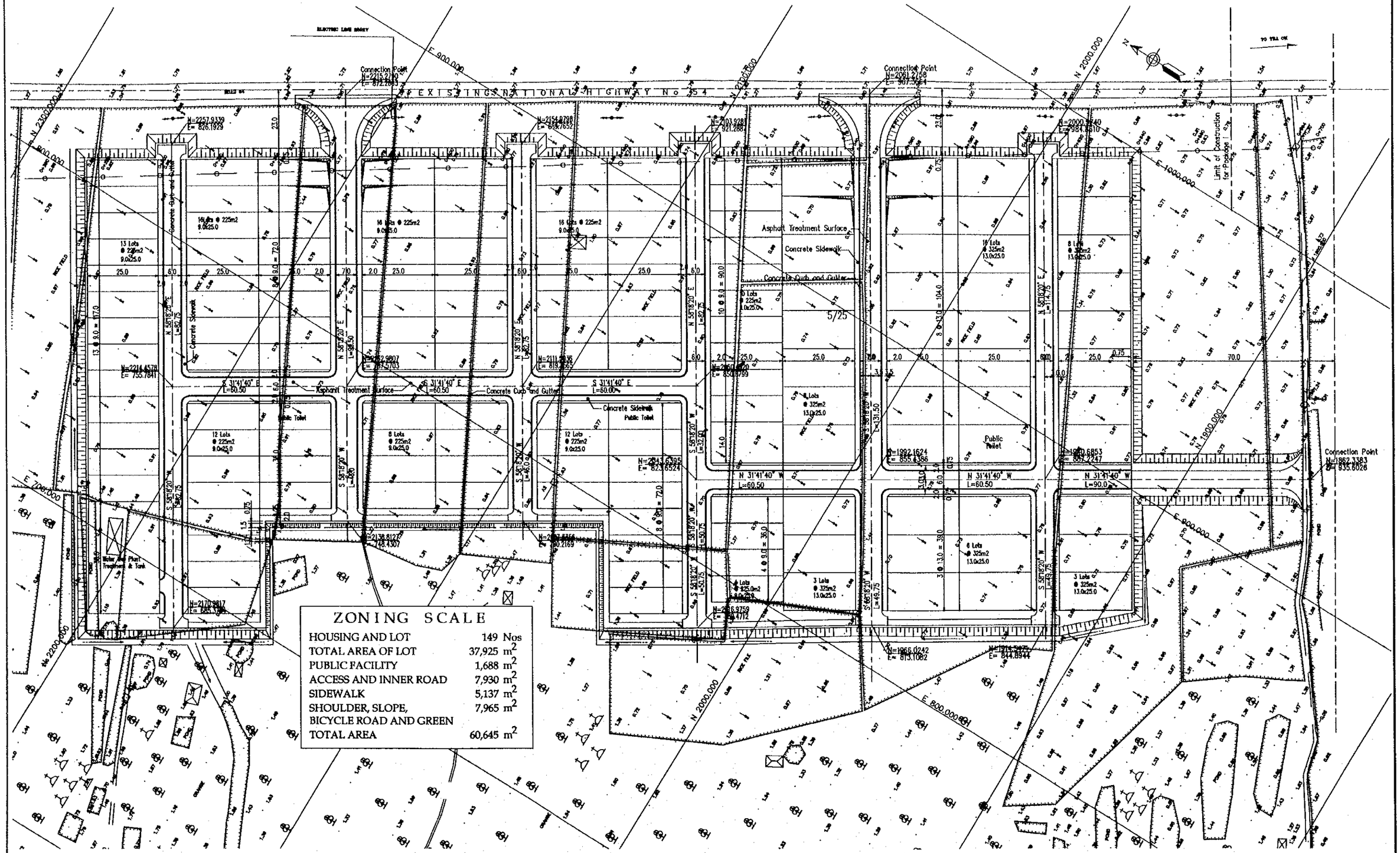
*W.T.P: Water Treatment Plant

The application of the "Implementation Schedule and Cost Estimate of the Land Acquisition and the Resettlement Areas of Can Tho Bridge Project" including the design of infrastructure described in this section was submitted to Ministry of Transport by PMU My Thuan on 6th March 2000.

The Minister of MOT approved this application on 28th April 2000 with the official letter, No.1042/QD-GTVT.

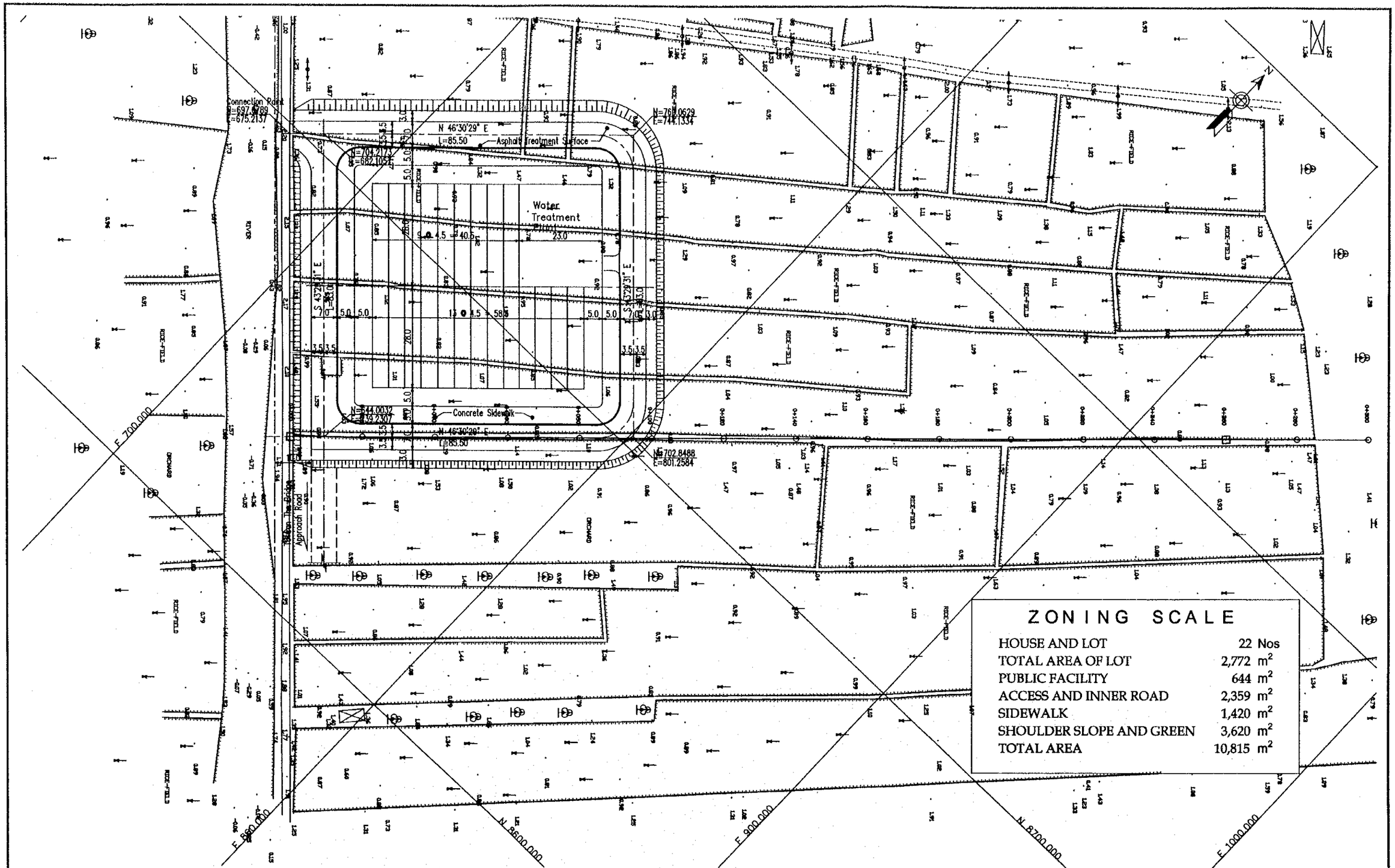


THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 7.38 Resettlement Area
	JAPAN INTERNATIONAL COOPERATION AGENCY



LOCATION PLAN
BINH MINH RESETTLEMENT AREA

THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 7.39 LOCATION PLAN BINH MINH RESETTLEMENT AREA
	JAPAN INTERNATIONAL COOPERATION AGENCY



ZONING SCALE

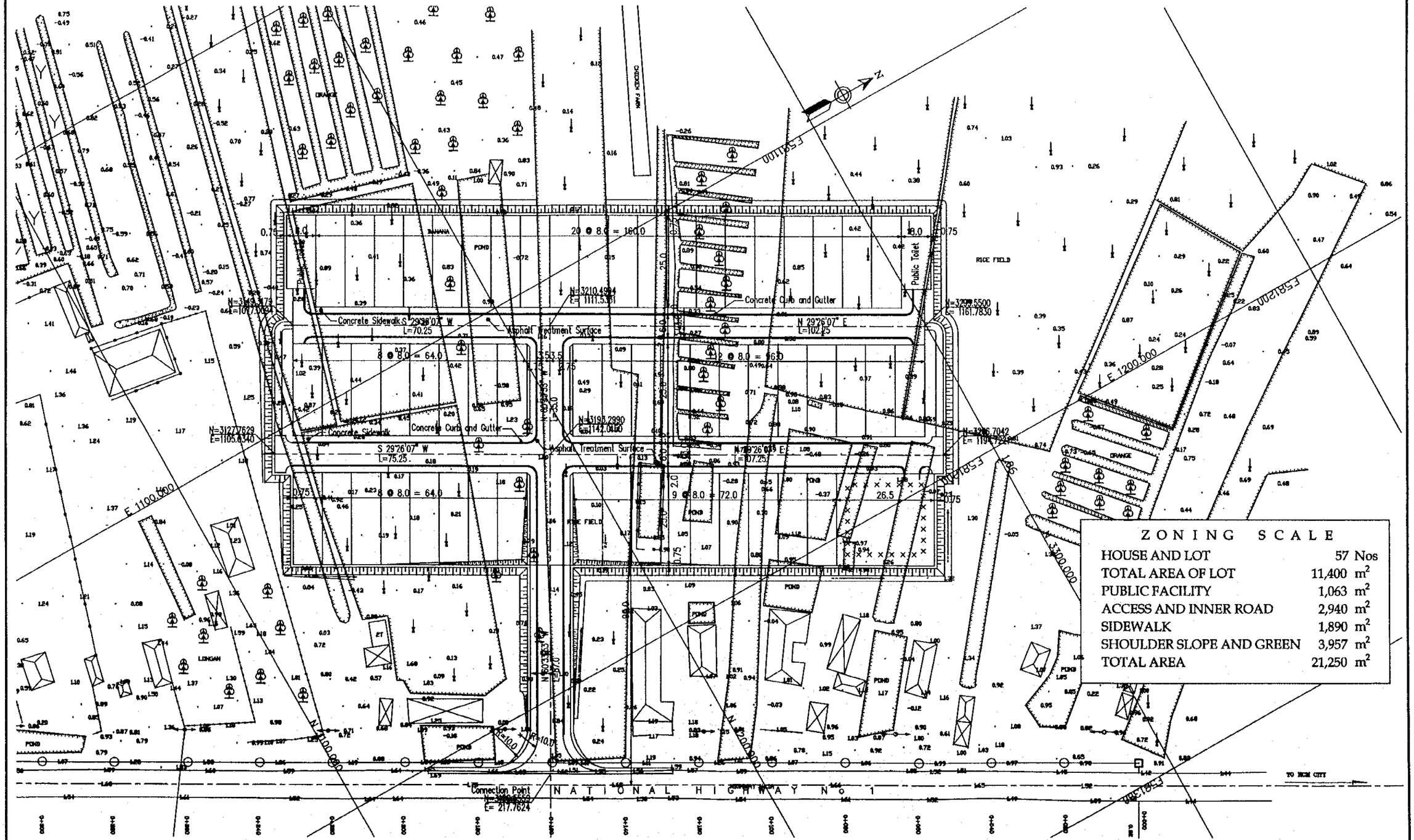
HOUSE AND LOT	22 Nos
TOTAL AREA OF LOT	2,772 m^2
PUBLIC FACILITY	644 m^2
ACCESS AND INNER ROAD	2,359 m^2
SIDEWALK	1,420 m^2
SHOULDER SLOPE AND GREEN	3,620 m^2
TOTAL AREA	10,815 m^2

LOCATION PLAN
HUNG PHU RESETTLEMENT AREA

THE DETAILED DESIGN OF
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Figure 7.40 LOCATION PLAN
HUNG PHU RESETTLEMENT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY



LOCATION PLAN
CHAU THANH RESETTLEMENT AREA

ZONING SCALE	
HOUSE AND LOT	57 Nos
TOTAL AREA OF LOT	11,400 m^2
PUBLIC FACILITY	1,063 m^2
ACCESS AND INNER ROAD	2,940 m^2
SIDEWALK	1,890 m^2
SHOULDER SLOPE AND GREEN	3,957 m^2
TOTAL AREA	21,250 m^2

THE DETAILED DESIGN OF
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Figure 7.41 LOCATION PLAN
CHAU THANH RESETTLEMENT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

Chapter 8

CONSTRUCTION PLANNING

CHAPTER 8 CONSTRUCTION PLANNING

8.1 Possible Sources of Construction Materials

8.1.1 Earth and Rock Materials

(1) Aggregate (Rock products)

Rock products is used for the coarse aggregate of concrete and also for the base course of road pavement. Quarries representing potential sources of aggregate were investigated. The location of these quarries is shown in Figure 3.4, and a summary of the evaluation survey is listed in Table 8.1

Table 8.1 Summary of Source of Rock surveyed

Quarry	Distance from site	Type of Rock	Description
Bien Hoa	350km	Andesite	Suitable for coarse aggregate of concrete (including High Strength Concrete) and base coarse of road pavement
Co To	120km	Granite	Suitable for coarse aggregate of concrete (including High Strength Concrete) and base coarse of road pavement
Vung Tau	220km	Granite	Suitable for base coarse of road pavement possible for C aggregate
An Giang	140km	Granite	Suitable for base coarse of road pavement only

* Note: Distance is for barge transportation.

(2) Natural sand

Natural sand is used for the fine aggregate of the concrete and also for the embankment filling of the approach road. Based on the various locations of potential sources, only some of these were investigated. All of the sources are shown in Figure 3.4, and summary of the suitability survey is listed in Table 8.2.

Table 8.2 Summary of Sources of Sand surveyed

Sources		Distance from site	Description
Dong Nai		400km	Fine sands suitable for fine aggregate of concrete and embankment filling of approach road.
Long Xuyen	Tan Chau	120km	As above
Soc Trang		120km	As above

* Note: distance is for barge transportation.

The sand from the Dong Nai river will be the most suitable for the fine aggregate for concrete, because of its quality and available quantity.

This source also has enough sand for the embankment filling of the approach roads.

On the other hand, river sand in Tan Chau area will be available for coarse aggregate of concrete.

In the site survey, dredging sand suitable for embankment has been found 1 to 8 km downstream of the bridge site.

For other potential sources, the entrance/ estuary of the Hau River will be considered. Dredging work at the estuary of the Hau River have been studied by the Belgium consultant between mid. 1995 and September 1998. This was the feasibility study for achieving and maintaining a safe navigation channel, and in 1990 and 1997, the river estuary was dredged (200,000m3 of sand in each year).

In the likelihood that this dredging project will be continued, a large quantity of sea sand will be dredged. Sea sand is not suitable for the fine aggregate of concrete; however, it is possible to use it for road embankment filling. Therefore, this dredging project will be considered as an alternative source for the embankment filling of approach roads.

8.1.2 Material Characteristics and Engineering Considerations

(1) Aggregate

Granite (occurring at Co To) and Andesite (occurring at Dong Nai) are available for both concrete and asphalt aggregate.

In addition, granite produced at Vung Tau may be used for concrete aggregate.

(2) Sand

Dong Nai sand and Tan Chau sand (near Long Xuyen) are coarse grained, which is suitable for concrete fine aggregate.

On the contrary, dredged sand around the bridge site is fine grained. This is suitable only for embankment materials.

8.1.3 Subsoil Survey Program for Detailed Design

(1) Aggregate (Coarse and Fine sand)

Physical properties are tested, i.e. grain size, specific gravity, unit weight, soundness and Los Angeles Abrasion. In addition, alkali reaction test is carried out especially for granite aggregates.

(2) Sand for embankment

For the river sand dredged near the bridge site, physical properties and the strength were tested i.e. grain size, specific gravity, unit weight moisture content, compaction and CBR.

(3) Concrete Trial Mix

High strength concrete (over 500kgf/cm2) is required for the Project, therefore, concrete trial mix is especially planned. Mixing test is carried out for a combination of local cement and aggregate, (Morning Star Cement Co., Vung Tau Granite agrregate and Tan Chau sand with admixture).

8.2 Procurement of Construction Materials

8.2.1 General

Many kinds of materials need to be procured for the Project, but according to the Vietnamese regulation, import of construction materials is restricted. Considering the following items, procurement of materials were surveyed by the Study Team:

- Required Specification
- Available Amount of Supply
- Condition of Transport
- Unit Price

The surveyed materials are listed in the following table:

Table 8.3 Surveyed Material

Material	Usage
1) Cement	- Concrete Production- Grout, Mortar Production
2) Sand	- Fine Aggregate of Cement Concrete- Fine Aggregate of Asphalt Concrete- Earthworks of Embankment, etc.- Subgrade - Structural Backfill- Sand Blanket of Soft Ground Treatment
3) Rock Products	- Base Course- Subbase Course- Aggregate for the Base of Substructures- Coarse Aggregate of Cement Concrete- Coarse Aggregate of Asphalt Concrete
4) Water	- Cement Concrete Production- Other Utilization for Construction
5) Reinforcement Steel	- Construction of PC and RC Structures
6) PC Strand, Stay Cables, and PC facilities	- Construction of PC Structures
7) Construction Steel	- Form work- Temporary Work Items

8.2.3 Cement

Cement is one of the major construction materials restricted from import, and some Vietnamese - Foreign joint factories have supplied this material.

The following factories were surveyed, and the cements of two companies (Chinfon & Morning Star) were used for the trial mixing of concrete testing, i.e., the slump and compressive testing by the Study Team.

Both of the tested cements satisfied the requirements of the concrete defined in the design criteria.

Table 8.4 List of the Cement Factories

Cement Factory	Conditions or Remarks
1) Chinfon Cement	- Joint factory between Vietnamese (VNCC)& Taiwanese
2) Morning Star Cement	- Joint factory between Vietnamese (Ha Tien)& Switzerland- New Plant was constructed in Kien Giang.
3) Nghison Cement	- Joint factory between Vietnamese & Japanese- New Plant has been under construction in Thanh Hoa, and one transportation terminal has been constructed in Ho Chi Minh City.

8.2.4 Earth and Rock Materials

(1) Rock products (Aggregate)

The following quarries were investigated, and the engineers of the Study Team evaluated the qualities, and quantities. Figure 8.1 shows the locations of the quarries, and the summary of the evaluation survey is listed in Table 8.5.

Table 8.5 Summary of the Source of Rock Products

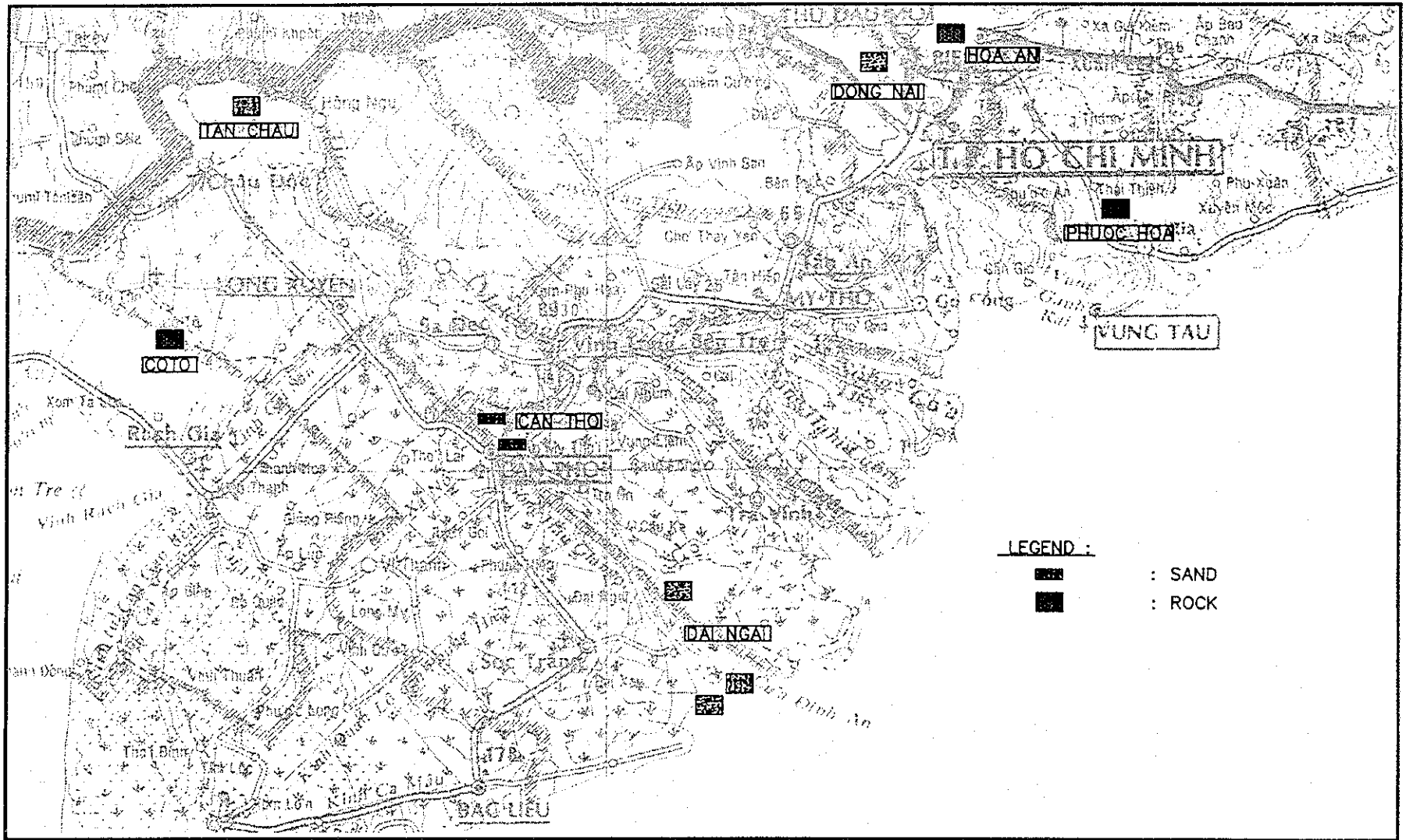
Source	Distance from site & Available Capacity for Supply	Type of Rock	Description
1) Co To	120km 2,000m3/day	Granite	Suitable for: - Base Course - Subbase Course - Aggregate for Cement Concrete (Including High Strength Concrete)
2) Phuoc Hoa (Nui Dinh)	290 km 250,000m3/year	Granite	Suitable for:- Base Course- Subbase Course
3) Hoa An	250km 8,000m3/day	Andesite	Suitable for: - Base Course- Subbase Course-Aggregate for Asphalt Concrete

(2) Sand

Based on the various locations of potential sources, only the following sites were investigated. The procurement of all investigated sources are river dredging. Locations of the sources are shown in Figure 8.1, and the evaluation survey is summarized in Table 8.6.

Table 8.6 Summary of the Source of Sand

Source	Distance from site & Available Capacity for Supply	Description
1) Can Tho	5km 5,000m^3/day	Suitable for: - Earth Fill Works of the Embankment
2) Dai Ngai	65 km 5,000m^3/day	Suitable for: - Subgrade - Structural Backfill - Drainage Blanket - Sand Compaction Pile
3) Dong Nai	250km	Suitable for: - Fine Aggregate for Asphalt Concrete - Fine Aggregate for Cement Concrete
4) Tan Chau	120km 4,000m^3/day	Suitable for: - Fine Aggregate for Asphalt Concrete - Fine Aggregate for Cement Concrete



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.1 Location of the Investigated Sources
	JAPAN INTERNATIONAL COOPERATION AGENCY

8.2.5 Water

Water for the construction works will be supplied from the well that will be dug in each construction yard. After the well is established, the supplied quality and quantity of the water is to be investigated.

8.2.6 Reinforcement Steel

Reinforcement steel is also one of the construction materials restricted from import. Some Vietnamese-Foreign Joint factories were surveyed, and most of the factories can supply the reinforcement steel with required quality and quantity. The standards of the production are based mainly on Vietnamese, Japanese, and ASTM standards.

However, the reinforcement steel with large size diameter might not be able to be procured, and the import will be required in this case.

8.2.7 PC Strand

There are some foreign suppliers that can supply the PC strand, anchorage, or stay cable of the Main Bridge, and other materials & equipment. Procurement from abroad is also one competitive alternative.

8.2.8 Construction Steel

Except the small size of shaped steel, the procurement of construction steel, namely, steel sheet pile, steel pipe pile, H-shaped beam, and other structural steel are not available in Viet Nam. Procurement from abroad is necessary.

8.3 Construction of the Main Bridge and Approach Span Bridge

8.3.1 Outline of the Construction Sequence of Main Bridge

(1) Construction of Pylon

Construction method of pylon is categorized into 3 stages.

The lower portion, from the top of pilecap to the cross beam is cast by the prefabricated staging method.

After the cross beam is constructed, the self climbing form (travelling formwork) is used for the casting of double columns of pylon.

At the final stage, namely, after the double columns of A shape pylon are connected, all staging method is applied for the casting of the top of pylon.

The casting works are done at the high and narrow places, so the carefully scheduled safety plan is required.

Figure 8.2 shows the general casting procedure of pylon.

(2) Prefabrication of Precast Segment of PC Girder

PC box girders are prefabricated and match-cast in the yard against each other, i.e., using the steam-cured casting system and stock piled. The weight of girder elements is limited to maximum 250 tons due to transportation restrictions and lifting machine capacity.

The construction yard has to have space to provide for form work, a short line and bed, stockyard, reinforcement-fabricating yard, concrete mixing plant, and space for stockpiling all materials. Pretensioning method is applied for the transverse prestressing.

Figure 8.4 shows the general figure of the "Short Line System" that is the prefabrication system of the precast segment of PC girder at site.

(3) Cantilever Erection from Pylons using Temporary Stay and Inner Prestressing Steel

Barges or heavy vehicles are used for the transportation of the fabricated segments from the casting yard to the place where the segments are to be lifted up.

The free cantilever erection method is used for construction of the superstructure. Fabricated elements are then assembled using the stay cable and inner cables. Two types of prestressing steel, namely, PC Bar and PC Strand are applied for the inner cables.

The launching procedure of the precast PC segment is shown in Figure 8.3.

(4) Production and Erection of Steel Girder Segments

Members of the steel girder segments are transported from the steel fabrication plant, and the transported members are assembled in the fabrication yard at the site.

Fabricated steel girder segments are transported and erected with the same method, equipment, and sequence with the PC segments.

(5) Installation and Stressing of Prefabricated Stay Cables

A fan layout of stay cables is used. Anchorages are provided with anti-fatigue devices. The tensioning jack has the capacity to transfer a 1,000tf ~ 2,000tf tensioning force to the cables which are composed of multi-strands. Several cables can be stressed at the same time.

The general figure of the installation of prefabricated stay cables is shown in Figure 8.2.

(6) Closure of Center Span

The final steel girder segment is fabricated at site with considering the adjustment to the installation into the closing portion of the center span.

The general figure of closure of the center span is shown in Figure 8.3.

8.3.2 Selection of Construction Method for Superstructure of the Main Span Bridge

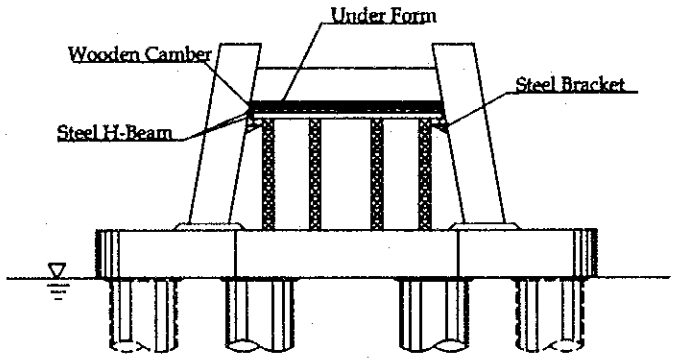
Construction methods for making elements of girders are characteristic of both methods are summarized as the following table precast segment and cast-in-situ concrete methods.

Table 8.7 Construction Method

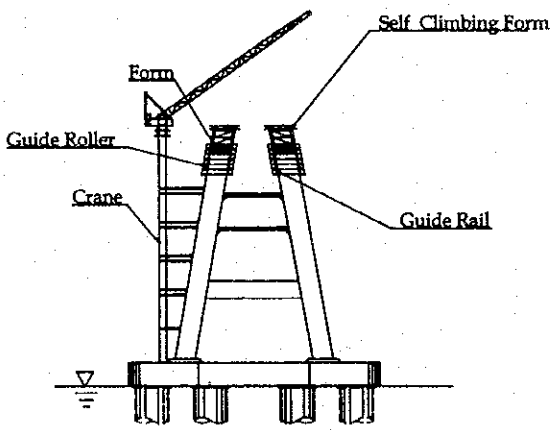
	Precast Segments Method	Cast-in-situ Concrete Method
Quality	Better uniform quality by quality control	Quality of concrete is uneven because it depends on skill of workers
Construction Period	Short period for simultaneous construction of substructure	Construction of superstructure can be done after completion of substructure, therefor construction period is longer.
Cost	EconomicalShort periodReuse of formworks	ExpensiveLong construction periodBig amount of manpower
Transportation of material	Easier transportation of precast segments	Transportation of law material to the site

The precast segmental method is recommended for the superstructure construction

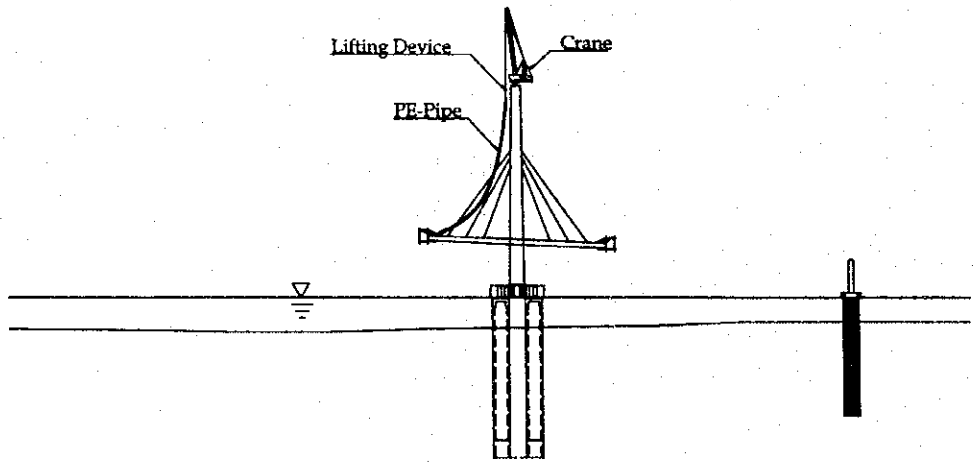
1 Main Tower Works (by Prefabricated Staging)



2 Main Tower Works (by Self Climbing Form)



3 Lift Up of Main Cable (PE-Pipe)



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.2 Launching Procedure of the Main Bridge (1)
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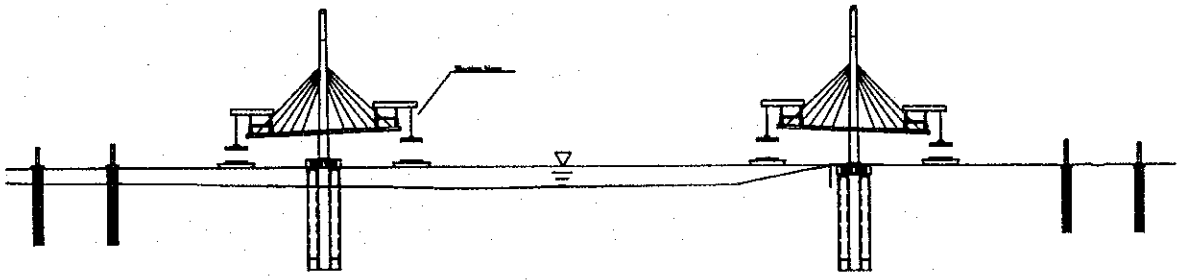
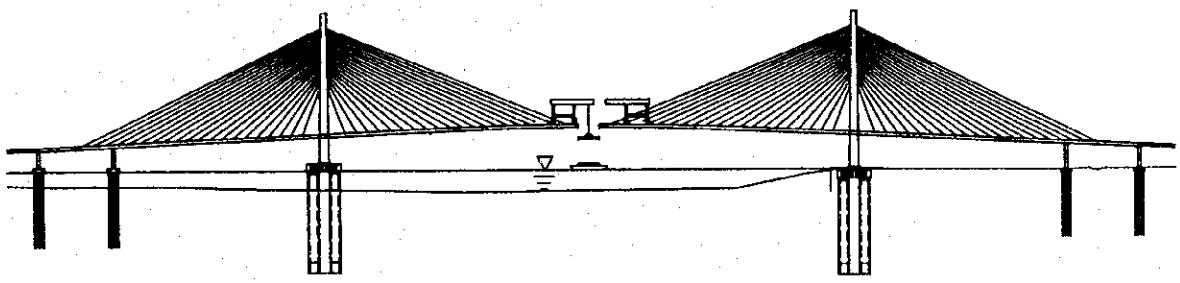
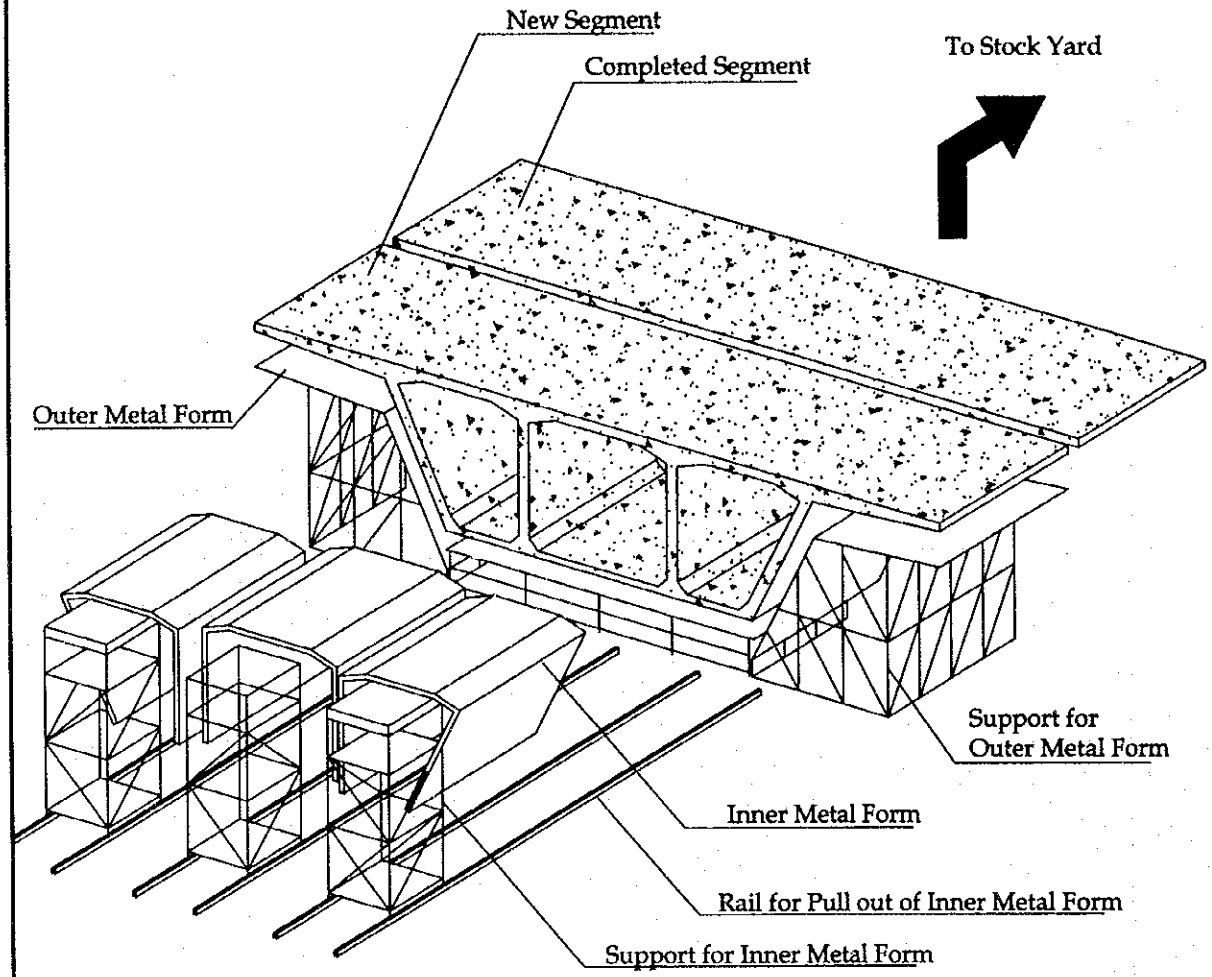
Erection of Girder Segment (Cantilever System)



Joint of Centre Span (Steel Girder)



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.3 Launching Procedure of the Main Bridge (2)
	JAPAN INTERNATIONAL COOPERATION AGENCY



With utilizing the manufactured formwork system, the precast segment is produced one by one at site. (Short Line System)

In this system, the concrete for new segment is placed into the form, with using the side surface of the adjacent completed segment as a part of the form.

This method improves the precise connection between these two segments.

THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.4 Prefabrication of Precast Segment in the Yard (Short Line System) JAPAN INTERNATIONAL COOPERATION AGENCY

8.3.3 Construction Method of Approach Span Bridges

(1) Construction methods

a) Prefabrication of precast segment in the yard

- Precast segments are fabricated using the short-line system in the yard and steam cured.
- The precast segment weight is limited to 150 ton. A 3.0m long segmental precast block is used.

b) Erection using erection truss

- Each segment is transported by track or barge. Segments are lifted by using the erection truss and joined using PC cables and epoxy resin.

(2) Production of the PC Composite I beam

In Package-2, the PC Composite I beam was planned with the precast segmental method.

The PC Composite I beam is cast in the Construction Yard No.3 and No.5 for Package-2.

The form has 4 separator boards inside, and one span length is cast at the same time. After the concrete hardened, form and each segment are separated, and stocked in the yard.

The concrete placing & separation of the formworks are shown in Figure 8.5 & 8.6.

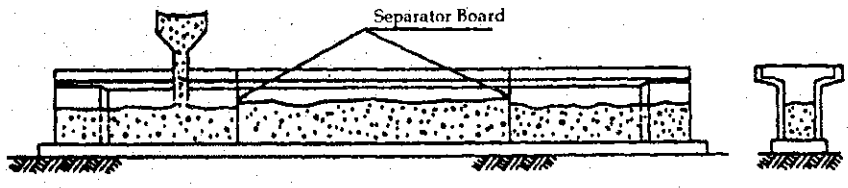


Figure 8.5 Concrete Placing for the Segment of PC Composite I beam

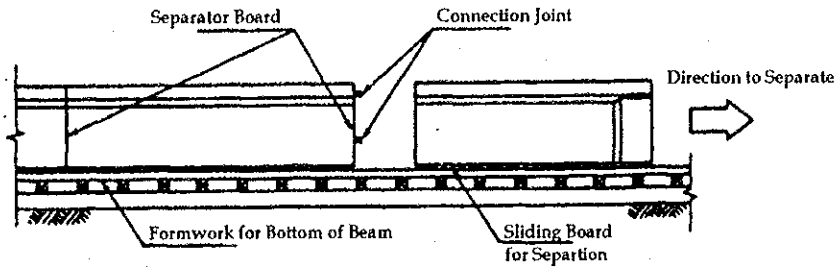


Figure 8.6 Separation of the Segment

The general layout of forms and storage yard are shown in Figure 8.11 and 8.12.

(3) Transportation and Erection of the PC Composite I beam

The length of one segment is 8m, and the weight is 18tf. Transportation from Construction Yard to the erection yards is performed by the trailer truck and barge.

At the erection yards, 5 segments are connected into one span beam with pre-stressing on the moving tables (Figure 8.7).

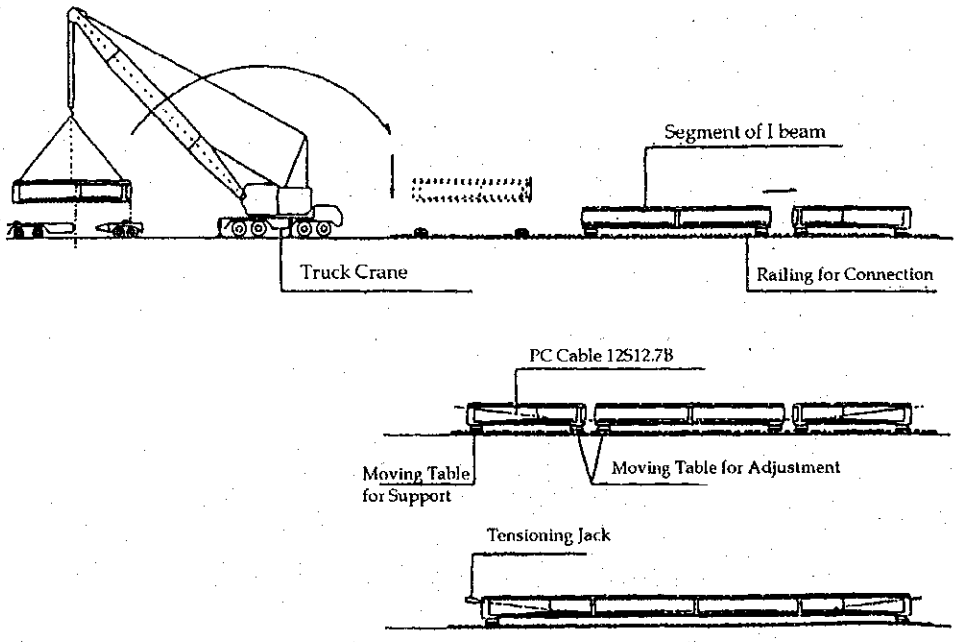


Figure 8.7 Connecting Work of Segment to 1 Span PC Composite I beam

After the connection of segments is completed, the erection is to be done. For the erection, two methods are planned, namely, "Erection Girder method" and "Erection with Stationary Gantry Crane method".

8.3.4 Construction of Bored Hole (Cast-in-situ) Pile

Cast-in-situ pile foundations are constructed in the drilled hole. A steel casing is used in the free water zone as a standpipe to prevent entry of water into the drilled hole and to protect from collapse. With reverse circulation drilling, a steel casing is lowered to the predetermined depth and the caged reinforcement bars are set inside the steel casing and the drilled hole. After pouring concrete to form cast-in-situ, the steel casing is removed.

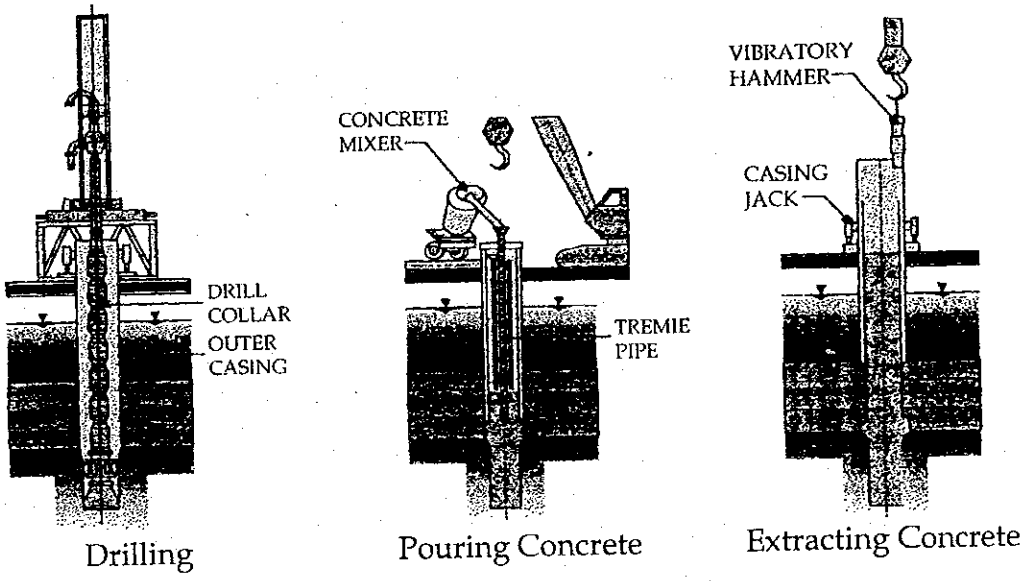


Figure 8.8 Bored Hole (Cast-in-situ) Pile

8.4 Temporary Works

Table 8.8 summarizes the major temporary works for each package, and the locations are shown on Figure 8.10:

Table 8.8 Temporary Works for Individual Package

<Package-1> (Approach Road on Vinh Long Side)	
1) Access Road for Site	
From B.P. to Tra On Bridge:	2.90km
From Tra On Bridge to Hau River:	1.80km
Total Length:	4.70km
* Indicated Length includes the length of temporary bridges shown below.	
2) Temporary Bridge in Access Road	
From B.P. to Tra On Bridge: 31m + 36m =	67m
From Tra On Bridge to Hau River: 24m+25m+30m =	79m
Total Length:	146m
<Package-2> (Main and Approach Span Bridges)	
1) Access Road for Site	
(Almost portion is "Temporary Bridge described below".)	
From Pile cap at Can Tho side to the A2 abutment at Riverbank of Can Tho side:	1.45km

* Indicated Length includes the length of temporary bridges shown below.

2) Temporary Bridge in Access Road

From Pile cap at Can Tho side to Sub stream of Hau River:	1,160m
From Sub stream of Hau River to Riverbank at Can Tho side:	140m
Total Length:	1,300m

* 60m width of horizontal navigational clearance is planned to secure the vessel traffic through the sub stream during construction.

<Package-3> (Approach Road on Can Tho Side)

1) Access Road for Site

From End of Package-2 to Cai Da Bridge:	3.00km
From Cai Da Bridge to E.P.:	4.50km
Total Length:	7.50km

* Indicated Length includes the length of temporary bridges shown below.

2) Temporary Bridge in Access Road

From End of Package-2 to Cai Da Bridge: 140m + 17m + 195m + 22m =	374m
From Cai Da Bridge to E.P.: 28m + 50m + 21m + 80m + 120m =	299m
Total Length:	673m

Typical Cross Sections of Access Road are shown in the following:

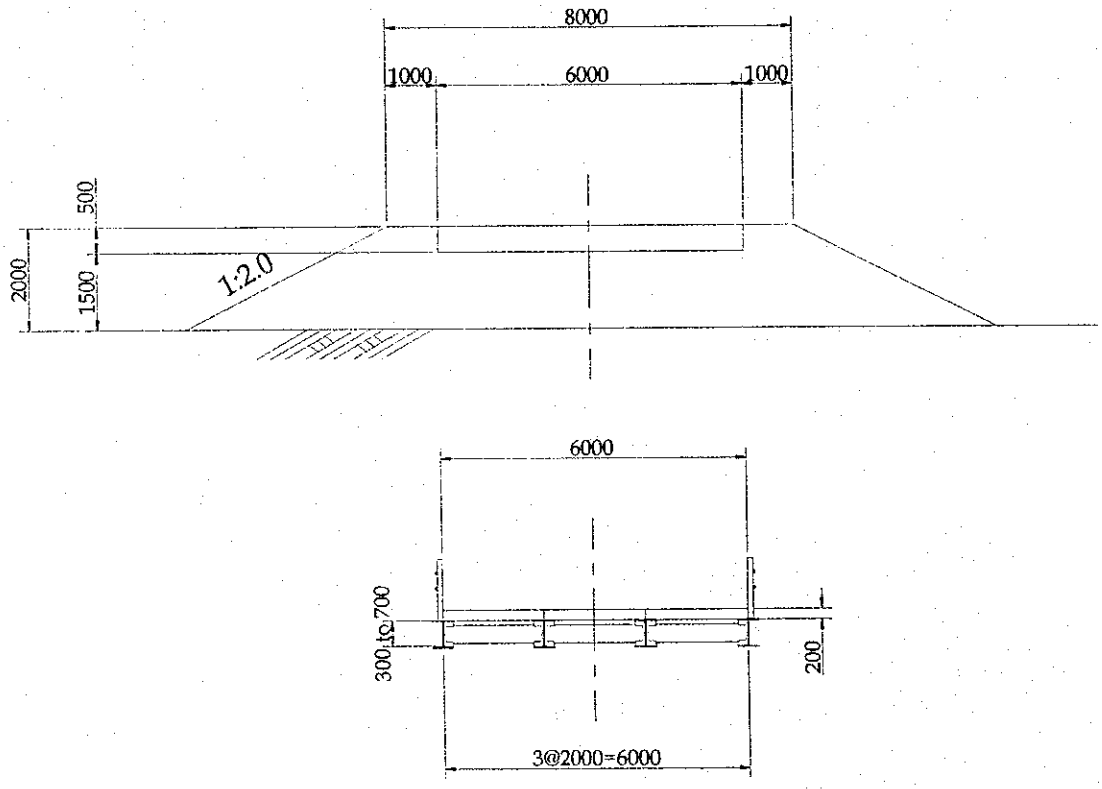


Figure 8.9 Typical Cross Section of Access Road

8.5 Construction Yards

Six construction yards are planned and located in the Project site as shown in Figure 8.10.

(1) Construction Yard No.1 & 2, for Package-1

Two areas are planned for the Package-1, Approach Road on Vinh Long side.

The general features are summarized in the following table:

Table 8.9 Construction Yard for Package-1

<Construction Yard, No.1>		
1)	Location:	Along the project alignment, between the N.H. No.54 and Tra On river
2)	Purpose:	Engineer & Contractor Office Equipment Maintenance & Material Stocking
3)	Area:	450m along the project alignment, 250m in the transverse direction About 11.25 ha
4)	Others:	The distance between the edge of the yard and the project alignment is about 60m.
<Construction Yard, No.2>		
1)	Location:	Near the B.P., southern side of Tra Va river
2)	Purpose:	Unloading of the material & equipment to be transported by barges from Tra Va river
3)	Area:	350m along the project alignment, 200m in the transverse direction About 7.0 ha
4)	Others:	One launching wharf is located. The distance between the edge of the yard and the project alignment is about 40m.

(2) Construction Yard No. 3, 4, & 5 for Package-2

For Package-2, the construction of Main and Approach Span Bridge, two yards are planned in both riversides of Hau River.

Figure 8.11 shows the general arrangement of equipment and facilities of yard No.3 in Vinh Long side, and Figure 8.12 shows those of yard No.4 in Can Tho side.

The general features are summarized in the following table:

Table 8.10 Construction Yard for Package-2

<Construction Yard, No.3>		
1)	Location:	Riverside of Hau River along the project alignment on Vinh Long side
2)	Purpose:	Production & Loading of the Precast Segment of PC Box Girder; Production & Loading of the Precast Segment of PC Composite I beam; Fabrication of the Segment of Steel Girder; Unloading & Stock Piling of Material & Equipment; and Engineer & Contractor Office
3)	Area:	300m along the project alignment, 750m in the transverse direction About 22.5 ha
4)	Others:	Two launching wharfs are located. One is for loading of segments, and another is for the unloading of material & equipment. The distance between the edge of the yard and the project alignment is about 60m. There are several residential houses along the riverbank at the location of this yard, and treatment for the daily activities of the residents must be undertaken by the Contractor.
<Construction Yard, No.4>		
1)	Location:	Riverside of Hau River along the project alignment on Can Tho side
2)	Purpose:	Production & Loading of the Precast Segment of PC Composite I beam; Unloading & Stock Piling of Material & Equipment; Engineer & Contractor Main Office; Living quarters for Local Labors; and Equipment Maintenance & Material Stocking
3)	Area:	650m along the project alignment, 300m in the transverse direction About 19.5 ha
4)	Others:	One launching wharf is located for the loading of segments. The distance between the edge of the yard and the project alignment is about 60m.
<Construction Yard, No.5>		
1)	Location:	Riverside of Cu Lao Lat facing to Hau River, along the project alignment
2)	Purpose:	Concrete Plant for the construction of the substructure & foundation of the Main & Approach Span Bridges on Can Tho side
3)	Area:	100m along the project alignment, 100m in the transverse direction About 1.0 ha
4)	Others:	The distance between the edge of the yard and the project alignment is about 35m.

In Package-2, the construction method of all types of superstructures is planned as the precast segment erection method, and the major work item is the production of these segments.

The types of superstructures and the number of precast segments to be produced or fabricated for the girder of Cable-stayed bridge in the individual yard are summarized in the following table:

Table 8.11 Summary of Segment Production (Yard No.3, Vinh Long side)

<Construction Yard No.3, Vinh Long side>		
- Approach Span Bridge, Vinh Long side		
PC Composite I beam:	4 x 3@40.0 = 480.0m,	
	5 segments for 1 Girder (40.0m)	
	9 Girders for 1 span	
	Unit length of 1 segment:	8.0m
	Unit weight of 1 segment:	18tf
	Total Number of the segment:	540
- Main Bridge (Hybrid Cable Stayed Bridge)		
PC Girder:	135 segments for side span	
	(140.0 + 130.0 = 270.0m for both side)	
	87 segments for center span	
	(550.0m - 200.0m(steel girder portion) = 350.0m)	
	Unit length of 1 segment:	4.0m
	Unit weight of 1 segment:	250tf
	Total Number of the segment:	222
Steel Girder:	33 segments for center span (210.0m)	
	Unit length of 1 standard segment:	12.0m
	Unit weight of 1 segment:	150tf

Table 8.12 Summary of Segment Production (Yard No 4, Can Tho side)

<Construction Yard No.4, Can Tho side>		
Approach Span Bridge, Can Tho side		
PC Composite I beam:	4@40.0 = 160.0m, 5 x 3@40.0 = 600.0m	
	Total Length: 760.0m	
	5 segments for 1 Girder (40.0m)	
	9 Girders for 1 span	
	Unit length of 1 segment:	8.0m
	Unit weight of 1 segment:	18tf
	Total Number of the segment:	855
PC Box Girder:	50.0 + 3@80.0 + 50.0 = 340.0m	
	~ Cast in Place, Form Traveler Erection ~	
	~ No Segment ~	
PC Composite I beam:	2@40.0 = 80.0m	
	5 segments for 1 Girder (40.0m)	
	9 Girders for 1 span	
	Unit length of 1 segment:	8.0m
	Unit weight of 1 segment:	18tf
	Total Number of the segment:	90

(3) Construction Yard No.6 for Package-3

Yard No.6 is the construction yard for Package-3, Approach Road on Can Tho side.

The general features are summarized in the following table:

Table 8.13 Construction Yard for Package-3

<Construction Yard, No.6>		
1)	Location:	Along the project alignment, facing on Cai Rang River
2)	Purpose:	Unloading of the material & equipments transported by barges from Cai Rang River
3)	Area:	400m along the project alignment, 200m in the transverse direction About 8.0 ha
4)	Others:	One launching wharf is located. The distance between the edge of the yard and the project alignment is about 35m.

8.6 Construction Schedule

The duration of construction works for the package 1, 2, and 3 are 47-month, 55-month, and 50-month, respectively. For the package-2 of the main bridge and approach span bridges, the 23-month foundation works for the tower pier construction is considered of which construction requires to deep foundation works and must be critical to the construction schedule.

The tentative construction schedule for Package-2 was shown in Figure 8.13.

NOTES

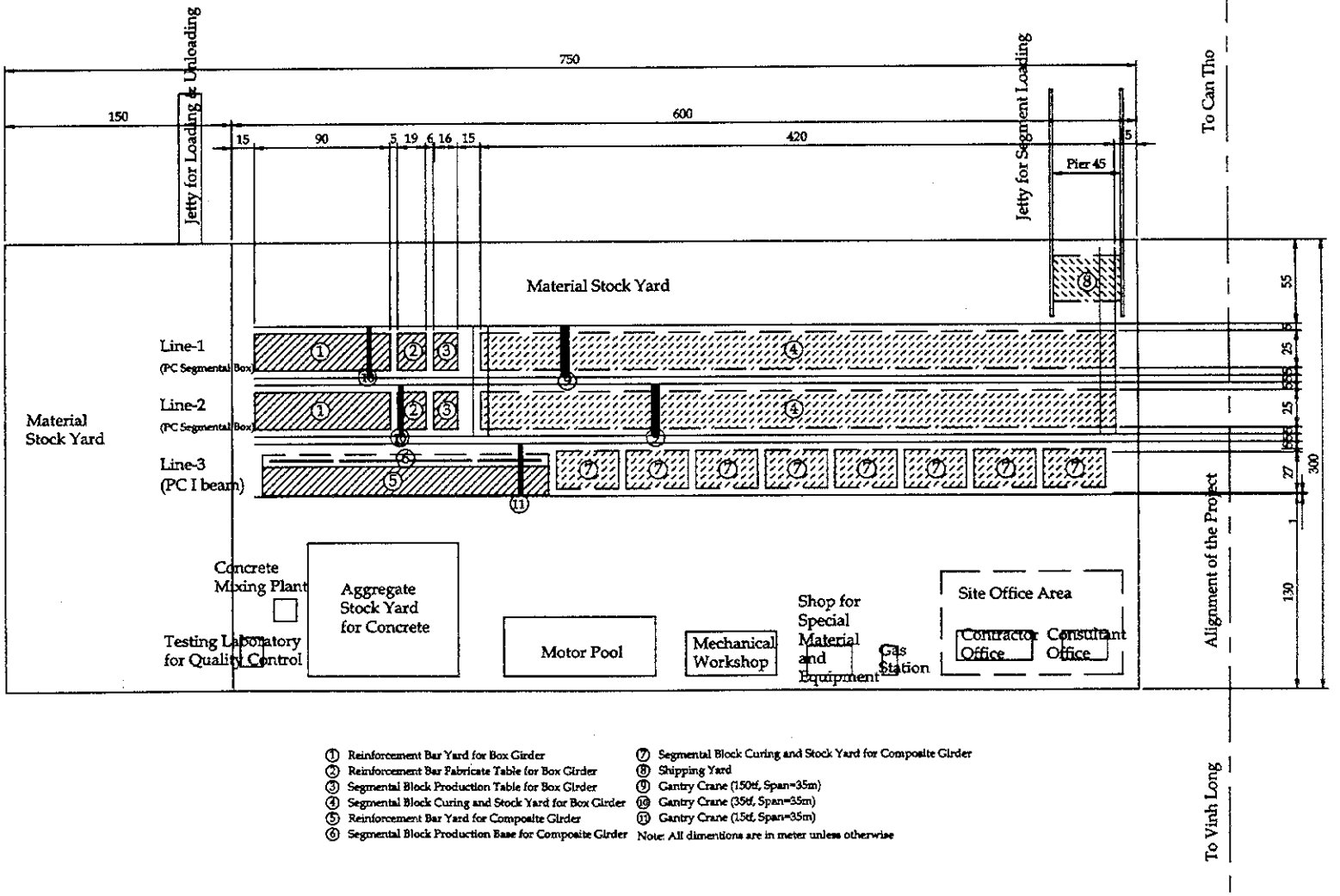
(1) Construction Yard No.1 for Package-1	350m x 200m, 7.0ha
(2) Construction Yard No.2 for Package-1	450m x 250m, 11.25ha
(3) Construction Yard No.3 for Package-2	300m x 750m, 22.5ha
(4) Construction Yard No.4 for Package-2	100m x 100m, 1.0ha
(5) Construction Yard No.5 for Package-2	650m x 300m, 19.5ha
(6) Construction Yard No.6 for Package-3	400m x 200m, 8.0ha
(7) Construction Office and Yard for Package 4	20m x 50m, 0.1ha
(8) Construction Office and Yard for Package 5b	20m x 50m, 0.1ha

Temporary Access Road Jetty for Loading and Unloading

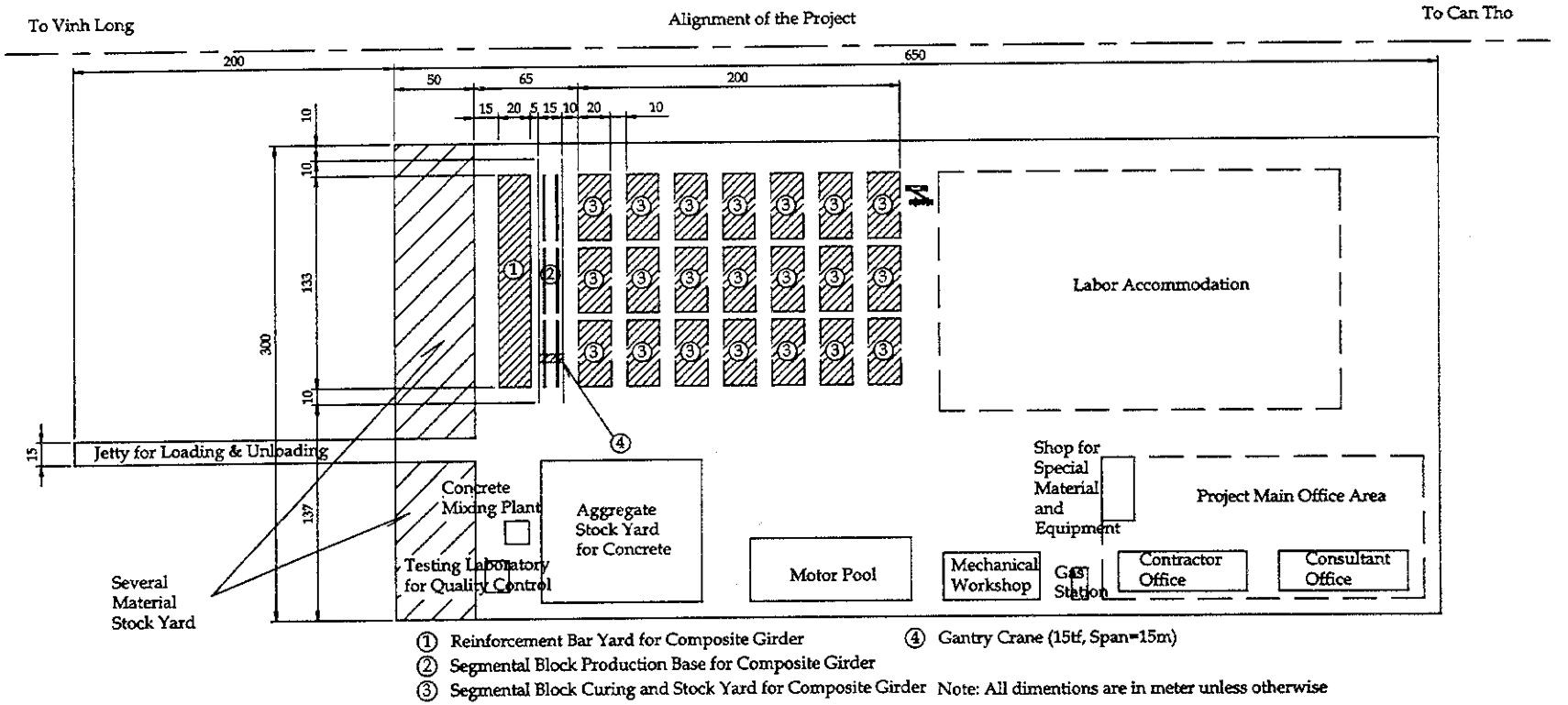
THE DETAILED DESIGN OF
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Figure 8.10 Location of the Construction Yard

JAPAN INTERNATIONAL COOPERATION AGENCY



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.11 Outline of Construction Yard, No.3
	JAPAN INTERNATIONAL COOPERATION AGENCY



THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Figure 8.12 Outline of Construction Yard, No.5
	JAPAN INTERNATIONAL COOPERATION AGENCY

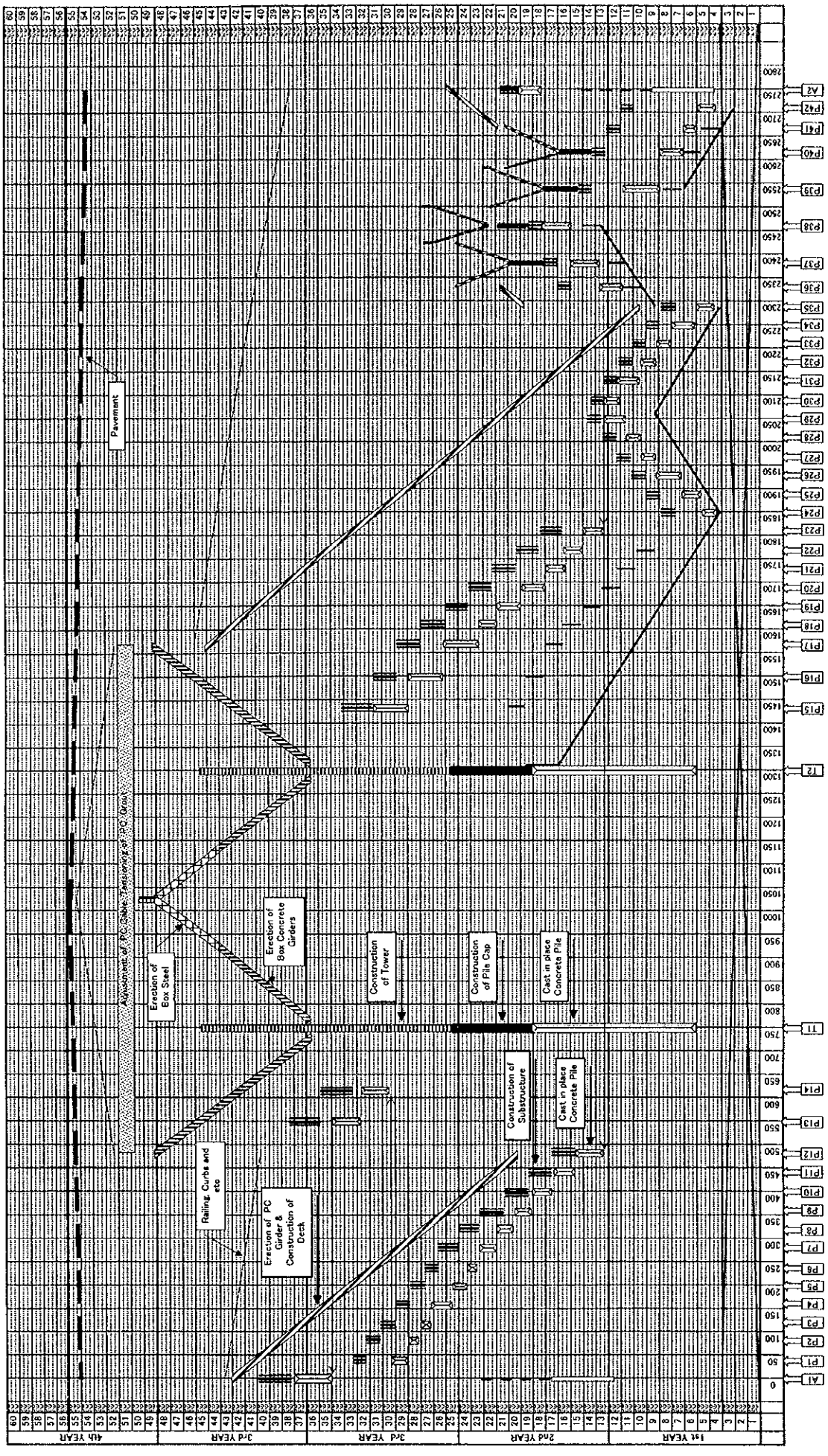


Figure 8.13 Tentative Construction Schedule for Main Bridge