# CHAPTER 15

## PRELIMINARY DESIGN AND COST ESTIMATE

# CHAPTER 15

# PRELIMINARY DESIGN AND COST ESTIMATE

## 15.1 DESIGN POLICY

### 15.1.1 Bridge Design

Bridge design was carried out in compliance with design criteria established in **Section 3.4.2.**

Under the improvement works, the method of construction sequence is crucial since it requires sophisticated monitoring of construction method. Due to the strong possibility that any slight imbalance or mistake during replacement works will cause the bridge to fall-down, the design for improvement works will consider the proposed construction methodology.

The PRRC has been implementing the construction of the linear park along Pasig River. Design of abutment areas will be conducted in coordination with the PRRC.

### 15.1.2 Highway Design

Highway design includes the following design items:

- Approach roads of the bridge
- Improvement of two (2) intersections
- Access road to/from Hospicio De San Jose from/to the bridge

**Intersections**

The problem with the existing intersections is that it is located at excessively wide areas. This condition poses traffic and pedestrian safety as well as traffic confusion problems.

The basic concept of an intersection design should be to keep its area to the minimum extent possible. MS-18 truck movements were considered in the intersection improvement design.

**Approach Road and Access Road**

The existing alignment dictates the need for alignment improvement design; the horizontal alignment of the center line of the bridge is maintained; the vertical alignment of the approach roads becomes slightly steeper corresponding to jacking-up of the superstructure by 25cm; the vertical alignment of the access road becomes slightly steeper as well.

### 15.1.3 Aesthetic Design

Aesthetic issues related to the Ayala Bridge improvement project were given an important consideration.

**Structural Beauty**

The appearance of the bridge including its functionality, is an important part of the public's perception about it. The structural beauty of Ayala Bridge has been accepted in a public consensus of aesthetic quality over the years.

**Historical Importance**

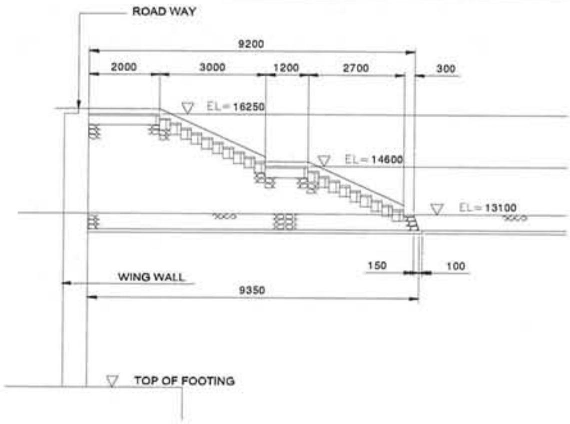
Historical aspect shall be given consideration in the aesthetic design of bridges. The National Historical Institute has listed Ayala Bridge as one of the historical bridge in the Philippines.

In terms of the permanency, the present Ayala Bridge should be given high evaluation.

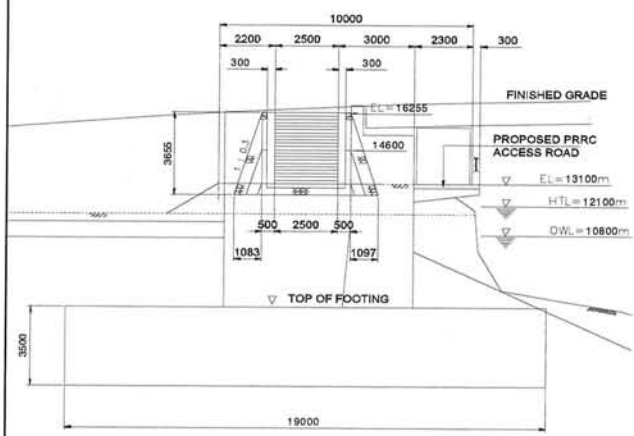
**Effects on Surrounding Environment**

The present Ayala Bridge has been incorporated as land scope and aesthetic assets over the years and expected to play a role as a structure giving a higher quality landscape to the surrounding environment.

The aesthetic design shall be made in coordination with PRRC's linear park plan, as shown in **Figure 15.1.3-1.**




A - Side View (Stair) of Scheme-2




B - Front View (Stair) of Scheme-2

C - Future View of Approach Promenade of Scheme-2

Figure 15.1.3-1 Proposed Access Road for PRRC

## 15.2 BRIDGE DESIGN

### 15.2.1 Design Criteria

Design criteria adopted to the design is shown in **Table 15.2.1-1**.

Table 15.2.1-1 Design Criteria

| | |
|---|---|
| I. SPECIFICATION | - AASHTO Standard Specification for Highway Bridges,<br>16th Edition 2000 including Division IA, Seismic Design<br>- Specification for Highway Bridges,<br>Japan Road Association, 1994 |
| II. MATERIALS | Concrete; f'c = 21 MPa<br>Reinforcing Steel; fy = 275 MPa<br>Structural Steel<br>- Steel Plates & Rolled Shape,<br>- Tubular Steel Piles; AASHTO M183, ASTM A36/A242<br>- Bolt; AASHTO M164 (ASTM A325)<br>- Welds; AD1.1 – 183, E70xx Series<br>Tubular Steel Piles; Load Capacity = 450 Tons |
| III. LOADS | - Deadloads<br>Reinforced Concrete = 24 kN/cu.m<br>Steel = 77 kN/cu.m<br>Earth Compacted = 19 kN/cu.m<br>- Highway Loads<br>AASHTO MS – 18 Loading<br>- Impact Loads<br>I = 15.24/L + 38, Where L = Length in meters<br>- Sidewalk Loads<br>For Span more than 20m Sidewalk Loading shall be 2.50 KPa<br>- Earthpressure<br>Mononobe – Okabe Method |

**Figure 15.2.1-1** shows the general view after strengthening works of Ayala Bridge.

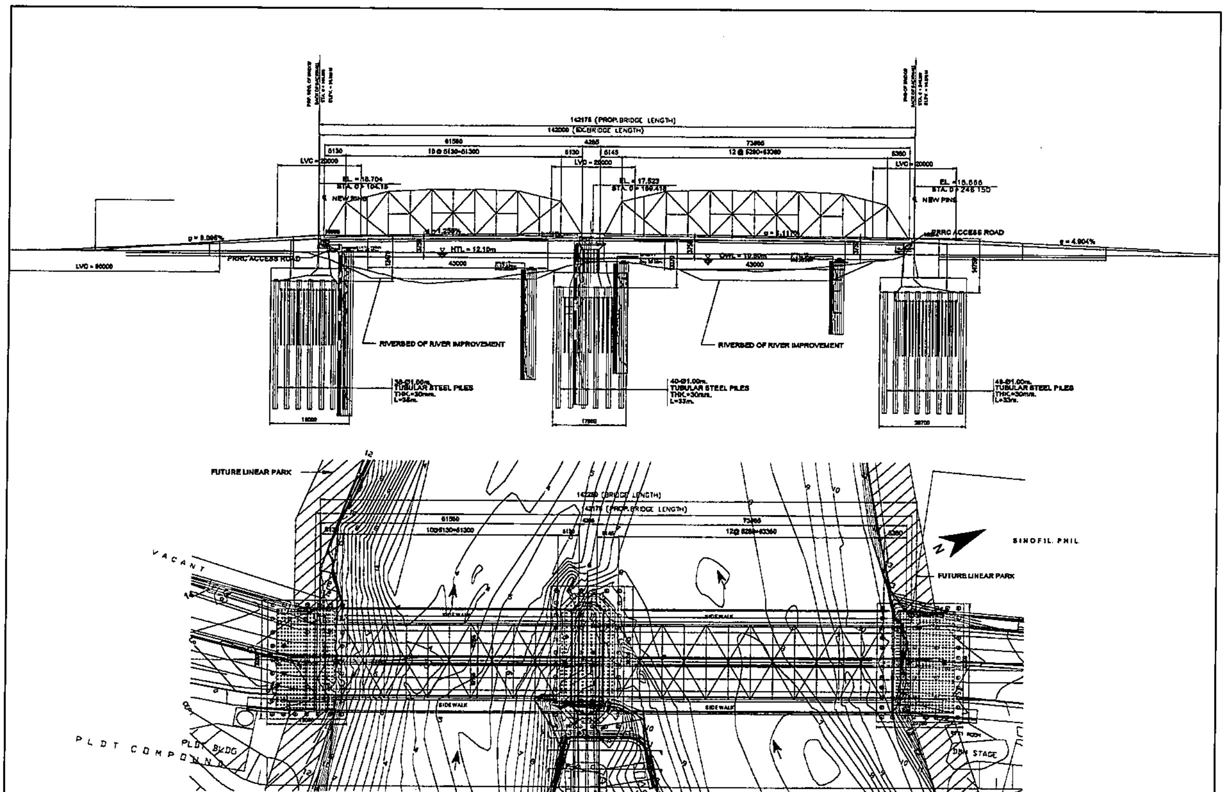


Figure 15.2.1-1 General View after Strengthening Works of Ayala Bridge

### 15.2.2 Superstructure

#### (1) Standard Cross Section

Distance between main trusses is exactly maintained in line with the policy of the improvement scheme as shown in **Figure 15.2.2-1.** The sidewalk width of downstream side is widened up to 3.0m and that of upstream side reduced to 3.0m.

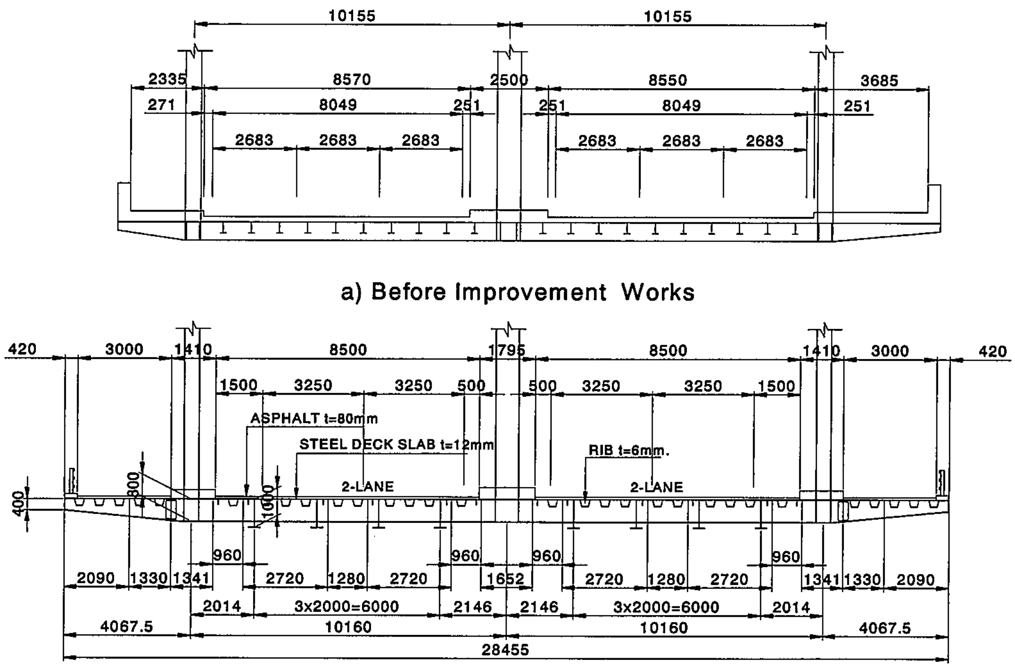



Figure 15.2.2-1 Standard Cross Section

#### (2) Preliminary Study on Main Members

##### (a) Steel Plate Deck

The replacement activities of lower chords necessitate that the steel plate deck maybe self-supported. The design of floor system is conducted, accordingly, assuming that temporary supports act as supporting points.

The newly installed steel plate deck is expected to be continuous structure with the temporary supports during construction. The dimensions of steel plate deck was determined in consideration of construction sequence accordingly.

##### (b) Cross Beam

Newly installed cross beams are presumed to support the floor system with bearing to the main frame trusses, even the floor system is continuously connected to the bottom chords.

Cross beams are modified as simple span beams with the span length equal to the spacing of main trusses. Dimensions of cross beams are determined by employing allowable stress method.

**Height of the Structural Member**

A cross beam 800 mm in height was simply determined to accommodate it to a bottom chord 1,000 mm in height.

**Determination of Main Dimensions**

The cross section of the end/intermediate cross beam are shown in **Figure 15.2.2-2.**

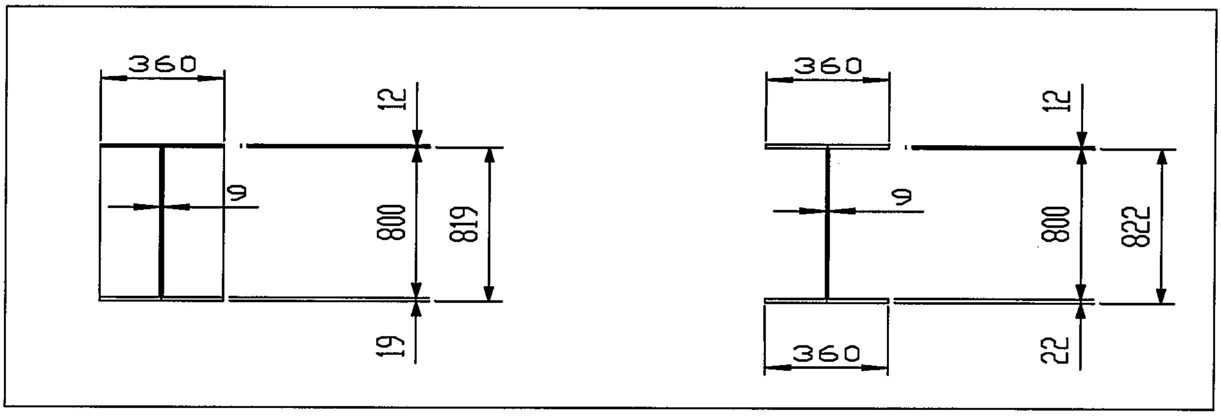



Figure 15.2.2-2 Main Dimensions of Cross Beams

**(c) Bottom Chord**

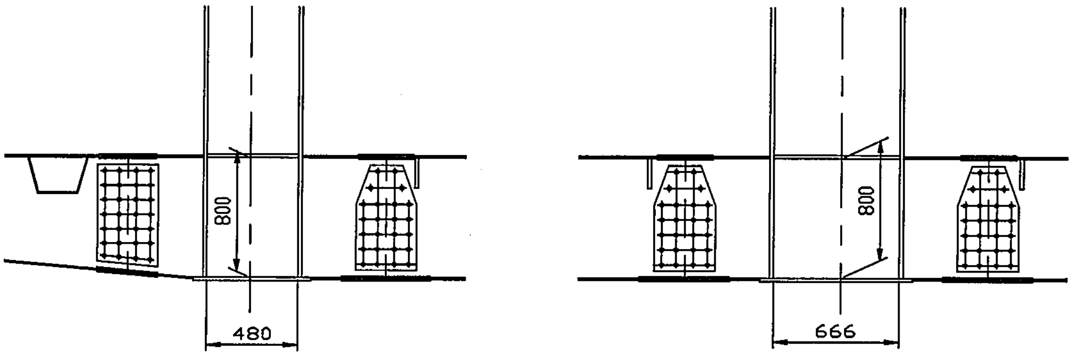
The load carrying capacity of the existing bottom chords is considerably insufficient for carrying the design live load because of section loss caused by heavy corrosion. The stress of bottom chord associated with dead load is to be reduced by the installation of the steel floor system instead of RC slab deck.

The new bottom chords are designed to secure the safety by installing bottom chords having the total section area equal to or more than that of original bottom chords.

**Determination of Main Dimensions**

A bottom chord 800 mm in height is equal to the cross beam height. The width of bottom chord is equal to that of existing dimension so that the vertical or diagonal members are connected to the bottom chord with bolts through gusset plates.

The cross sections of the newly installed outer and center bottom chords are shown in **Figure 15.2.2-3.**




(a) Outer Bottom Chord (b) Center Bottom Chord

Figure 15.2.2-3 Major Dimension of Bottom Chord

### 15.2.3 Substructure

#### (1) Design Criteria

This section provides the standards, specification and other references that was used in the design of the substructures for the Ayala Bridge which were analyzed and evaluated in close coordination with the DPWH - URPO.

#### (a) Features

The abutments are seat type resting on ø1.00m tubular steel pipe pile with fixed connection to the superstructure while pier is on movable connection resting on tubular steel pipe piles.

#### (b) Design Codes, Manuals, Specification and References

- Standard specification for highways bridges AASHTO, 17th Edition 2000 specification
- National Structural Code of the Phil. Vol. II Bridges
- Japan Road Association (JRA) 1994 Edition

#### (c) Materials

| | | |
|---|---|---|
| Concrete | – Compressive Strength | = 21MPa |
| Structural Steel | – Yield Strength | = 248MPa A36 (36,000psi) |
| Reinforcing Steel | – Yield Strength | = 275MPa (Grade 40) |
| Tubular Steel Pile | – Allowable capacity | = 450 kN (Based on the results of soil data analysis) |

#### (d) Loads

- Dead Loads :

| | |
|---|---|
| Concrete | = 24kN/m$^3$ |
| Steel | = 77kN/ m$^3$ |
| Compacted Earth | = 19kN/ m$^3$ |

- Liveload : AASHTO standard trucks loading MS-18 (HS20-44) or the corresponding lane loading.
- Seismic Load : Seismic performance Category D<br>Soil Profile Type = III<br>Seismic Acceleration = 0.4g
- Other Loads : Other design loads shall be in accordance with AASHTO specifications and the National Structural Code of the Phil. Vol. II Bridges.

**(2) Analysis Procedure**

Multimode spectra method is used in the analysis of the substructure of the Ayala Bridge. For the retaining abutment that is to displace horizontally, the Pseudo Static Mononobe-Okabe method of analysis is used in computing lateral active soil pressures during seismic loading. The components connecting the superstructures to the abutment (e.g. Bearing, Shear key, etc.) is designed to resist the forces specified in Art.7.2.1 of AASHTO Div.1A

**(3) Analysis Results**

**Figures 15.2.3-1** to **Figure 15.2.3-3** show the capacity/demand ratio of each structural components of the substructure.

**(4) Coordination With PRRC**

**(a) Requirement from PRRC**

The PRRC stated that the plan for the linear park along Pasig River will take longer time to materialize in some river sections because of the right of way problem. In this sense, it is required that every bridge crossing the Pasig River shall be planned to provide an access road which connect the promenade of upstream and downstream sides on both riverbanks.

**(b) Comparison of Approach Promenade**

Two (2) schemes of access roads are considered as shown in **Figure 15.2.3-4**

Scheme - 1 Box culvert is provided at the back of Mainwall
Scheme - 2 Open access road is provided in front of Mainwall

As a result of coordination meeting with PRRC, the open access road scheme 2 is more applicable because of the following reasons:

- The box culvert scheme has disadvantages for the pedestrian because of the safety of the pedestrians/users against lawless elements, lighting system, maintenance, ventilation facilities and rampant informal dwellers might use it as their homes.

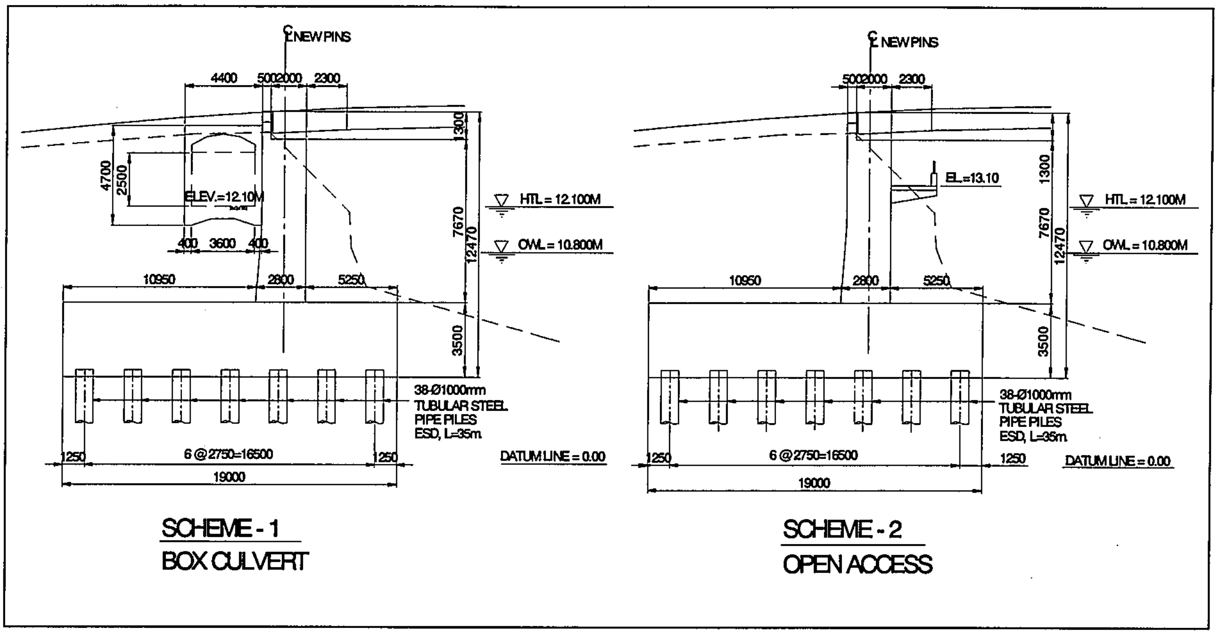
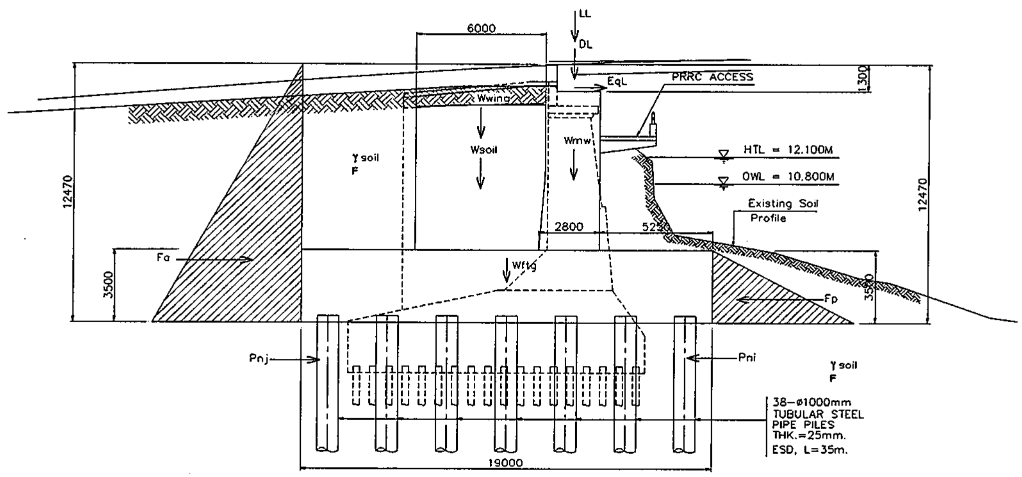



Figure 15.2.3-4 Comparison of the Proposed Access Road for PRRC Linear Park

### (c) Proposed Approached Promenade

The proposed approached promenade is shown in **Figure 15.2.3-5.** The ideal approach stairs which are requested by PRRC is also provided so that the pedestrians/users can access the linear park from the bridge. This proposed access road will also be applied to other bridges with enough space in front of abutments if possible.

## DESIGN IMPROVEMENT OF ABUTMENT A




| Part | DL (Ton) | EQ (Ton) |
|---|---|---|
| Superstructure | 483 | 449 |
| Main Wall | 2166 | 541 |
| Footing | 5239 | 1309 |
| Wing Wall | 132 | 33 |
| Soil | 6521 | 1630 |
| Soil Values | | |
| ɣ soil | 1.94 | Ton/m3 |
| ø | 30 | Deg |

| Pile Capacity | | Comb1 | Comb2 | Comb3 |
|---|---|---|---|---|
| Pni, Pnj | Pure Tension (Ton) | 173 | 173 | 328 |
| | Pure Comp. (Ton) | 450 | 450 | 598 |
| | Shear (Ton) | 354 | 354 | 470 |
| Allowable Stresses | | Comb1 | Comb2 | Comb3 |
| Pni, Pnj | Pure Bending (Mpa) | 163 | 163 | 217 |
| | Pure Comp.(Mpa) | 148 | 148 | 198 |

Load Combinations:

Comb1=DL+LL+EP+BF OWL

Comb2=DL+LL+EP+BF HTL

Comb3=DL+EQ+EP+BF OWL

Note: For Passive Soil @ Downstream Level with Top of Footing

Earth Pressure: by Mononobe-Okabe Eq.

| | | | |
|---|---|---|---|
| Factive,Fa | Comb1&2 | 1581 | Ton |
| | Comb3 | 2930 | Ton |
| Fpassive,Fp | Comb1&2 | 126 | Ton |
| | Comb3 | 860 | Ton |

Bouyant Force

| | | |
|---|---|---|
| OWL | 3544 | Ton |
| HTL | 4119 | Ton |

DL = Total Dead Load

LL = Live Load

EQ = Total Seismic Load

EP = Total Earth Pressure

Fp = Passive Soil Force

ɣ soil = unit weight of soil

ø = soil angle of friction

OWL = Ordinary Water Level

HTL = High Tide Level

Critical Pile Demand

| Load Comb. | | Comb1 | Comb2 | Comb3 |
|---|---|---|---|---|
| Pni | Tension | - | - | - |
| | Comp | 266 | 251 | 463 |
| | Bend | 59 | 59 | 322 |
| Max Comb s Ratio | | 0.45 | 0.44 | 0.94 |
| | Shear | 38 | 38 | 160 |
| Pnj | Tension | - | - | - |
| | Comp | 373 | 358 | 156 |
| | Bend | 59 | 59 | 322 |
| Max Comb s Ratio | | 0.55 | 0.54 | 0.72 |
| | Shear | 38 | 38 | 160 |

Critical Pile C/D Ratio

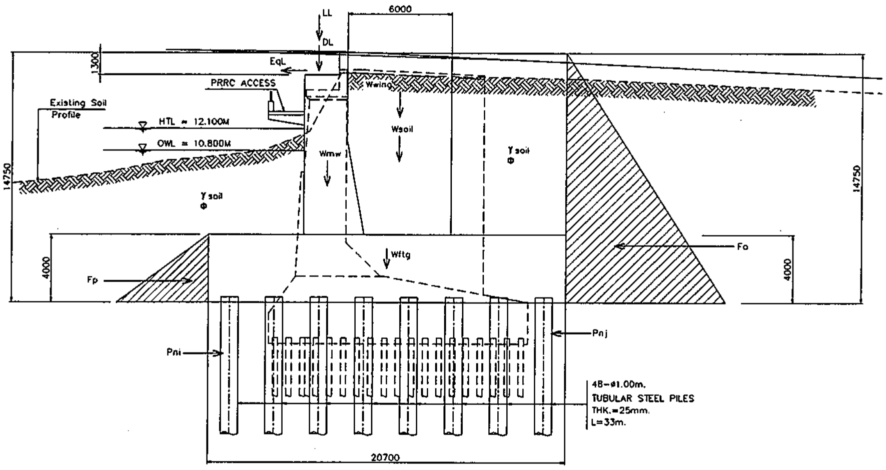
| | | Comb1 | Comb2 | Comb3 |
|---|---|---|---|---|
| Pni | Comp | 1.69 | 1.79 | 1.29 |
| | Stress | 2.22 | 2.27 | 1.06 |
| | Shear | 9.30 | 9.30 | 2.90 |
| Pnj | Tension | - | - | - |
| | Stress | 1.82 | 1.85 | 1.38 |
| | Shear | 9.30 | 9.30 | 2.90 |

Number of Piles: 38

| Other Components | Capacity | Demand | Unit | C/D Ratio |
|---|---|---|---|---|
| Mainwall | | | | |
| - Shear | 2081 | 1316 | KN | 1.58 |
| - Flexure | 8210 | 7036 | $mm^2$ | 1.16 |
| Wingwall | | | | |
| - Shear | 1939 | 839 | KN | 2.31 |
| - Flexure | 18472 | 16798 | $mm^2$ | 1.09 |
| Footing | | | | |
| - Shear | 2586 | 2389 | KN | 1.08 |
| - Flexure | 10178 | 8813 | $mm^2$ | 1.15 |

Figure 15.2.3-1 Tabulation of Final Stresses and Capacity/Demand Ratio for Abutment A

## DESIGN IMPROVEMENT OF ABUTMENT B




| Part | DL (Ton) | EQ (Ton) |
|---|---|---|
| Superstructure | 577 | 469 |
| Main Wall | 3308 | 827 |
| Footing | 6523 | 1631 |
| Wing Wall | 189 | 47 |
| Soil | 8130 | 2033 |
| Soil Values | | |
| ɣ soil | 1.94 | Ton/m3 |
| ø | 30 | Deg |

| Earth Pressure: by Mononobe-Okabe Eq. | | | |
|---|---|---|---|
| Factive,Fa | Comb1&2 | 2238 | Ton |
| | Comb3 | 4146 | Ton |
| Fpassive,Fp | Comb1&2 | 165 | Ton |
| | Comb3 | 1123 | Ton |

| Bouyant Force | | |
|---|---|---|
| OWL | 5102 | Ton |
| HTL | 5737 | Ton |

DL = Total Dead Load
LL = Live Load
EQ = Total Seismic Load
EP = Total Earth Pressure

Fp = Passive Soil Force
ɣ soil = unit weight of soil

ø = soil angle of friction
OWL = Ordinary Water Level
HTL = High Tide Level

| Pile Capacity | | Comb1 | Comb2 | Comb3 | Load Combinations: |
|---|---|---|---|---|---|
| Pni, Pnj | Pure Tension (Ton) | 173 | 173 | 328 | Comb1=DL+LL+EP+BF OWL |
| | Pure Comp. (Ton) | 450 | 450 | 598 | Comb2=DL+LL+EP+BF HTL |
| | Shear (Ton) | 354 | 354 | 470 | Comb3=DL+EQ+EP+BF OWL |
| Allowable Stresses | | Comb1 | Comb2 | Comb3 | Note: For Passive Soil @ Downstream Level with Top of Footing |
| Pni, Pnj | Pure Bending (Mpa) | 163 | 163 | 217 | |
| | Pure Comp.(Mpa) | 148 | 148 | 198 | |

Critical Pile Demand

| Load Comb. | | Comb1 | Comb2 | Comb3 |
|---|---|---|---|---|
| Pni | Tension | - | - | - |
| | Comp | 262 | 248 | 465 |
| | Bend | 64 | 61 | 268 |
| Max Comb s Ratio | | 0.45 | 0.47 | 0.46 |
| | Shear | 43 | 43 | 167 |
| Pnj | Tension | - | - | - |
| | Comp | 370 | 357 | 143 |
| | Bend | 64 | 61 | 268 |
| Max Comb s Ratio | | 0.57 | 0.56 | 0.64 |
| | Shear | 43 | 43 | 167 |

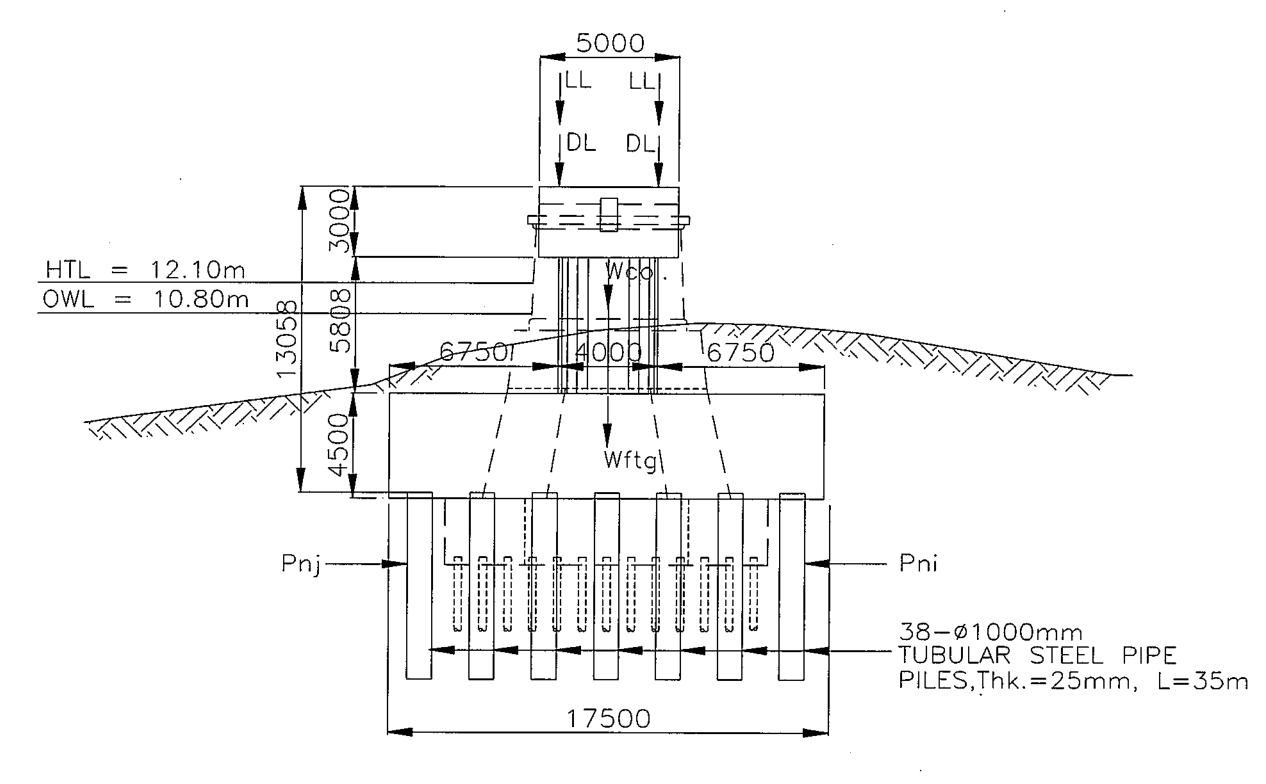
Critical Pile C/D Ratio

| | | Comb1 | Comb2 | Comb3 |
|---|---|---|---|---|
| Pni | Comp | 1.71 | 1.81 | 1.28 |
| | Stress | 2.12 | 2.17 | 1.15 |
| | Shear | 8.23 | 8.23 | 2.81 |
| Pnj | Tension | 1.22 | 1.26 | 4.18 |
| | Stress | 1.75 | 1.78 | 1.56 |
| | Shear | 8.23 | 8.23 | 2.81 |
| Number of Piles | | 48 | | |

| Other Components | Capacity | Demand | Unit | C/D Ratio |
|---|---|---|---|---|
| Mainwall | | | | |
| - Shear | 2619 | 1862 | KN | 1.40 |
| - Flexure | 10723 | 9024 | $mm^2$ | 1.18 |
| Wingwall | | | | |
| - Shear | 18472 | 1089 | KN | 2.20 |
| - Flexure | 17472 | 17506 | $mm^2$ | 1.05 |
| Footing | | | | |
| - Shear | 3004 | 2981 | KN | 1.01 |
| - Flexure | 10178 | 9972 | $mm^2$ | 1.02 |

Figure 15.2.3-2 Tabulation of Final Stresses and Capacity/Demand Ratio for Abutment B

## IMPROVEMENT DESIGN OF PIER




| Part | | |
|---|---|---|
| DL @ South Superstruct. (Ton) | 483 | |
| DL @ North Superstruct. (Ton) | 577 | |
| Lane Load + Sidewalk Liveload | 504 | |
| Elastic Shear @ bottom of Footing | 2603 | |
| Elastic Moment @ bottom of Footing | 20016 | |
| Column | 117 | Ton |
| Footing | 6765 | Ton |
| Soil Values | | |
| ɣ soil | 1.94 | Ton/m3 |
| Ø | 30 | Deg |
| Bouyant Force | | |
| OWL | 3187 | Ton |
| HTL | 3331 | Ton |

Load Combinations:

Comb1=DL+LL+EP+BF OWL

Comb2=DL+LL+EP+BF HTL

Comb3=DL+EQ+EP+BF OWL

Legend:

DL = Total Dead Load

LL = Live Load

EQL = Total Longitudinal Earthquake Load

EQT = Total Transverse Earthquake Load

ɣ soil = unit weight of soil

Ø = soil angle of friction

OWL = Ordinary Water Level

HTL = High Tide Level

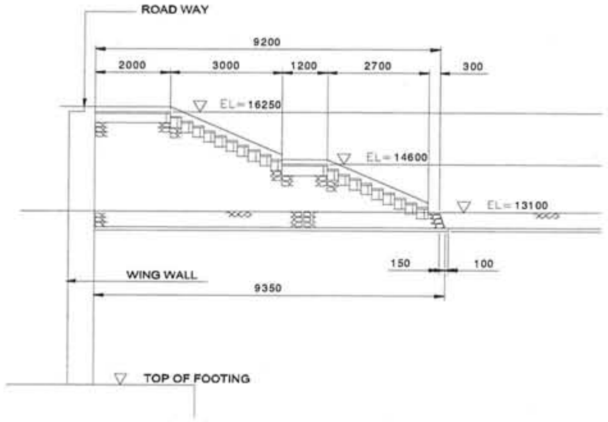
| Pile Capacity | | Comb 1&2 | Comb 3 |
|---|---|---|---|
| Pni, Pnj | Pure Tension (Ton) | 309 | 450 |
| | Pure Comp. (Ton) | 450 | 598 |
| | Shear (Ton) | 354 | 470 |

| | | Pile Demand | | | | | |
|---|---|---|---|---|---|---|---|
| | | Longitudinal | | | Transverse | | |
| Load Comb | | Comb1 | Comb2 | Comb3 | Comb1 | Comb2 | Comb3 |
| Pni | Tension | - | - | - | - | - | - |
| | Comp | 211 | 208 | 330 | 211 | 199 | 250 |
| | Bend | - | - | 136 | - | - | 149 |
| Max Comb S Ratio | Ratio | 0.20 | 0.19 | 0.49 | 0.20 | 0.19 | 0.44 |
| | Shear | - | - | 65 | - | - | 67 |
| Pnj | Tension | - | - | - | - | - | - |
| | Comp | - | - | 68 | 211 | 199 | 148 |
| | Bend | - | - | 136 | - | - | 149 |
| Max Comb S Ratio | Ratio | - | - | 0.30 | 0.20 | 0.19 | 0.37 |
| | Shear | - | - | 65 | - | - | 67 |

| Critical Pile C/D Ratio | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pni | Comp | 2.13 | 2.16 | 1.80 | 2.53 | 2.26 | 2.39 |
| | Stress | 4.35 | 4.55 | 2.04 | 5.00 | 5.26 | 2.27 |
| | Shear | - | - | 7.23 | - | - | 7.00 |
| Pnj | Comp | - | - | 8.79 | 5.00 | 5.26 | 4.04 |
| | Stress | - | - | 3.30 | - | - | 2.70 |
| | Shear | - | - | 7.23 | - | - | 7.00 |
| Number of Piles | | 40 | | | | | |

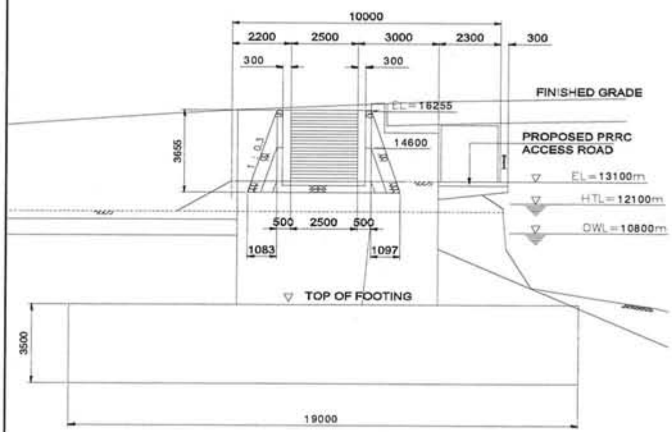
| | Longitudinal | | Transverse | | Unit | C/D Ratio | | Remarks |
|---|---|---|---|---|---|---|---|---|
| Other Components | Capacity | Demand | Capacity | Demand | | Longitudinal | Transverse | |
| Column | | | | | | | | |
| - Shear | 0.76 | 0.29 | 0.76 | 0.04 | MPa | 2.62 | 19.00 | |
| - Flexure | 36224 | 282179 | 36224 | 1869886 | kN-m | 7.79 | 51.62 | |

Figure 15.2.3-2 Tabulation of Final Stresses and Capacity/Demand Ratio for Pier




A - Side View (Stair) of Scheme-2

C - Future View of Approach Promenade of Scheme-2




B - Front View (Stair) of Scheme-2

Figure 15.2.3-5 Proposed Access Road for PRRC

## 15.3 Highway Design

### 15.3.1 Design Criteria

The highway design was carried out based on the following criteria and standards:

- Design Guidelines and Standards for Public Works and Highways, Volume – 11
- A policy on Geometric Design of Highways and Streets, 2001 (AASHTO)
- Highway Capacity Manual, Special Report, Transportation Research Boar, 1999
- Road Structure Ordinance, Japan Road Association, 1983 (JRA)

This study basically followed the standards of the Philippines. However, in case that there are some lacking items or, from the standpoint of economic consideration, appropriate standards are established by referring to other provisions.

The design speed was determined from the limitations described in **Section 15.1.2. Table 15.3.1-1** shows the study on relationship between design speed and grade specified by Japan Road Association (JRA).

Table 15.3.1-1 Relationship between Design Speed and Grade

| Design Speed (km/h) | Desirable Grade (%) | Exception | |
|---|---|---|---|
| | | Grade (%) | Maximum Slope Length (m) |
| 80 | 4 | 5<br>6<br>7 | 600<br>500<br>400 |
| 60 | ⑤* | 6<br>7<br>⑧* | 500<br>400<br>300 |
| 50 | 6 | 7<br>8<br>9 | 500<br>400<br>300 |
| 40 | 7 | 8<br>9<br>10 | 400<br>300<br>200 |

Source: JRA * : applicable for this design.

The approach roads and access road have the following dimensions:

| | | | |
|---|---|---|---|
| * Approach road of south side : | Proposed Slope Length | L = 53m < Maximum Length | Grade = 8% |
| * Approach road of north side : | Proposed Slope Length | L = 89m < Maximum Length | Grade = 5% |
| * Access road to Hospicio de San Jose : | Proposed Slope Length | L = 60m < Maximum Length | Grade = 8% |

Note: Grades of approaching roads near to the intersections are 1.223% for the south side intersection and 0.618% for the north side intersection, which meet both the AASHTO and JRA requirements.

From the relationship among the grade, and the maximum slope length and proposed slope length, the design speed is correspondent to 60km/h.

### 15.3.2 Cross Sections

**Figure 15.3.2-1** shows road sections after improvement works in the study area.

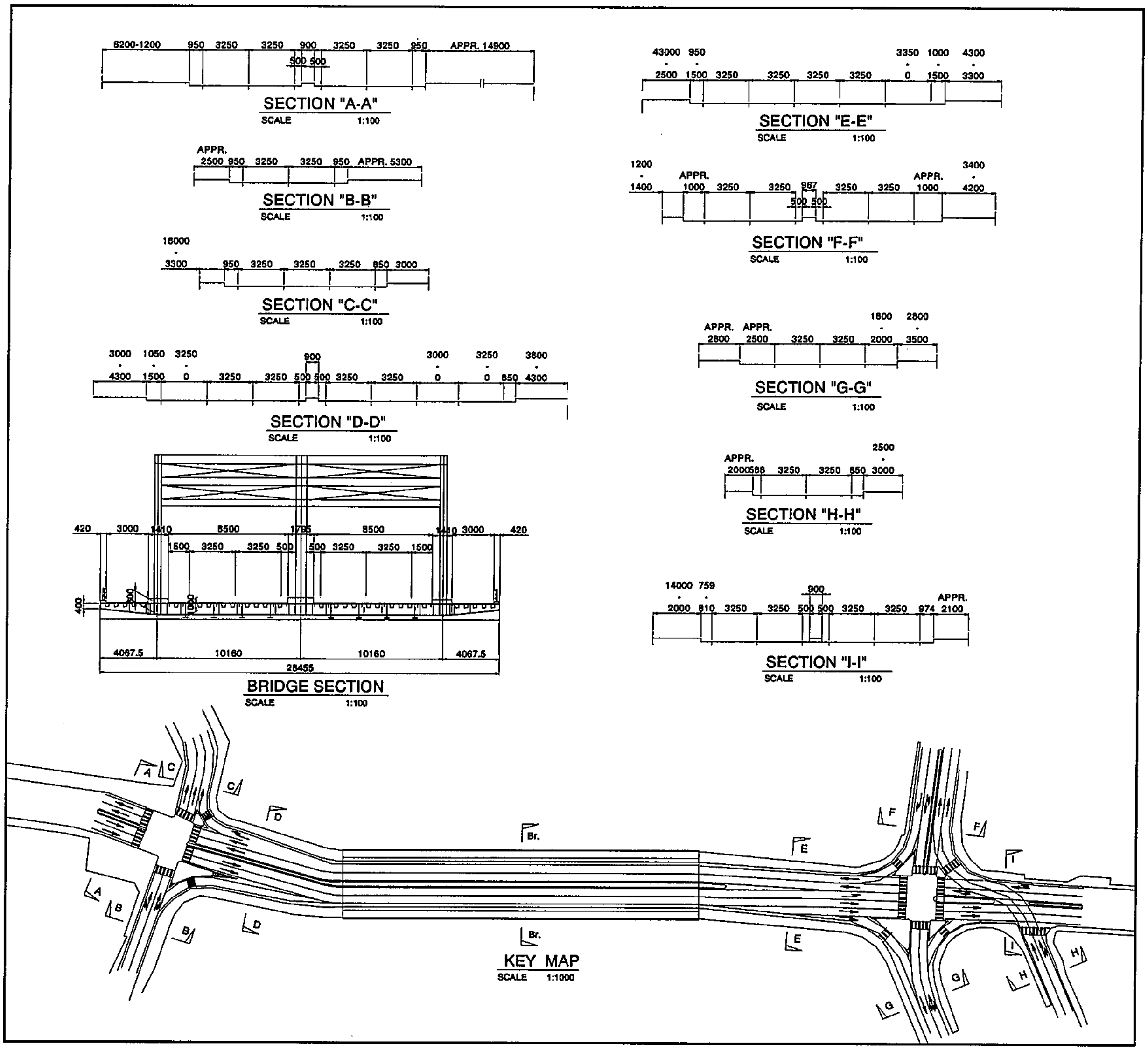



Figure 15.3.2-1 Road Cross Sections after Improvement Works

### 15.3.3 Intersection Design

**Figure 15.3.3-1** shows the south side and north side intersections of the bridge before and after improvement works.

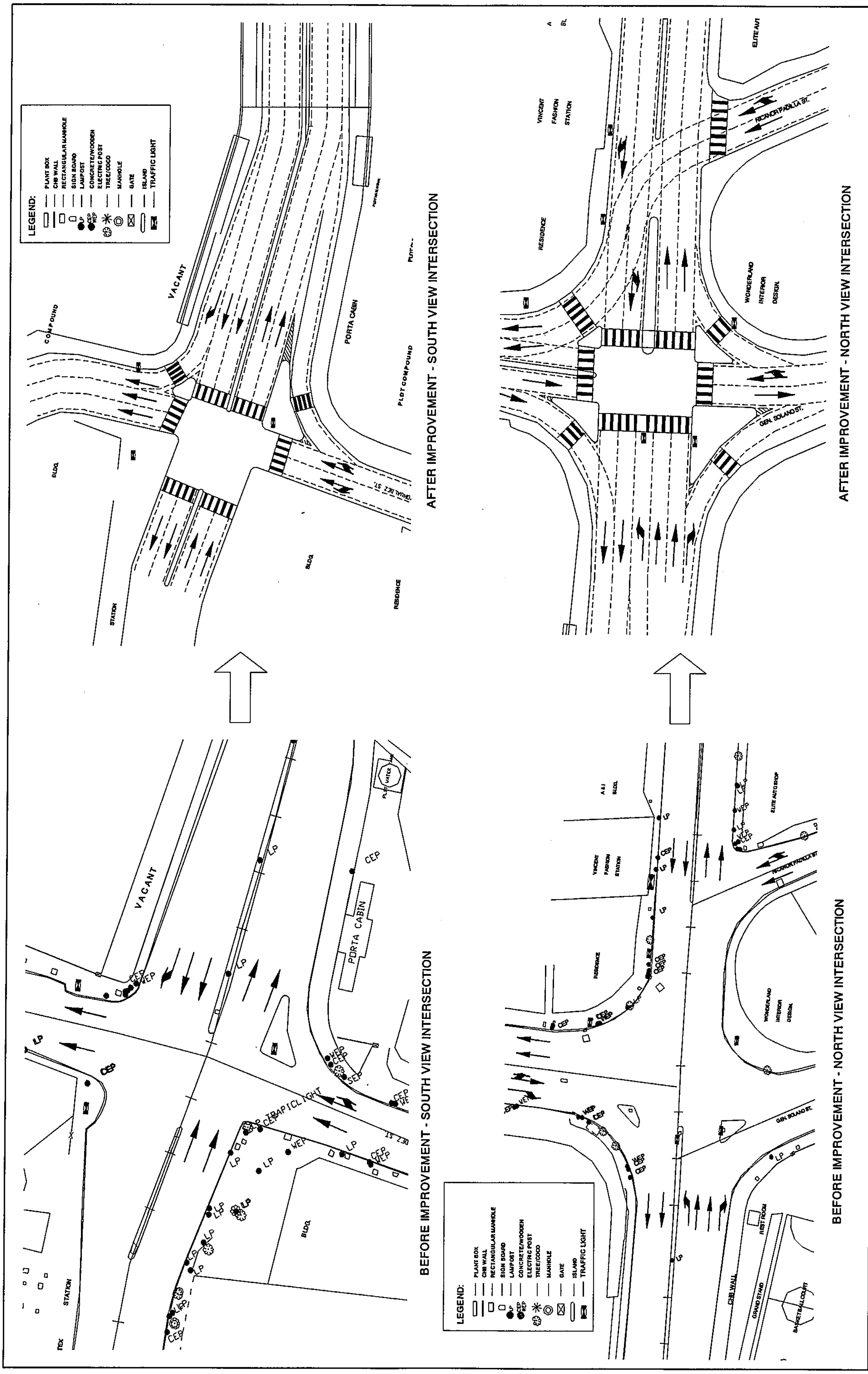



Figure 15.3.3-1 Proposed Improvement of Intersections

## 15.3.4 Access Road to Hospicio De San Jose

**Figure 15.3.4-1** shows the access road going to the Hospicio De San Jose before and after improvement works.

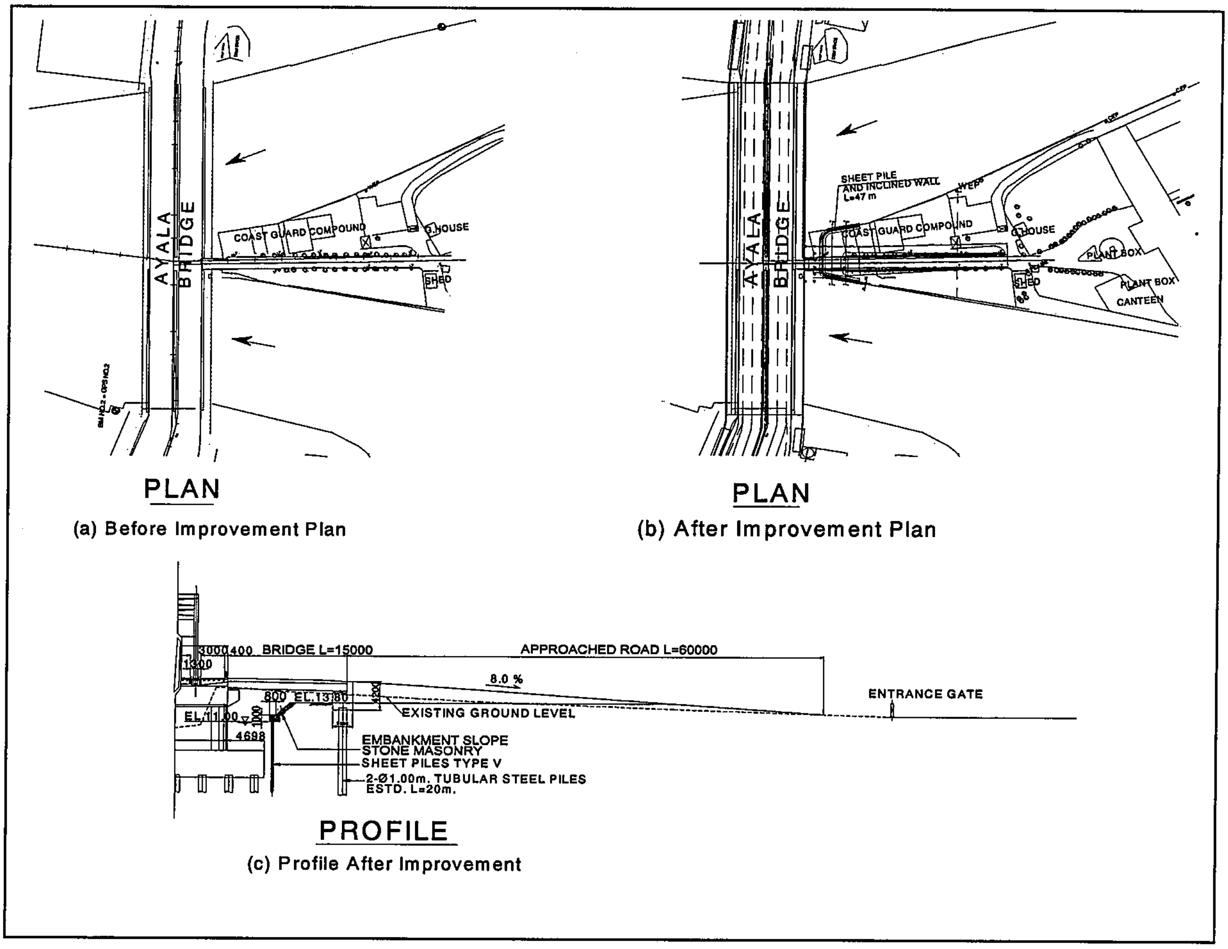



Figure 15.3.4-1 Access Road to Hospicio De San Jose

## 15.4 PROTECTION TO VESSEL COLLISION

There are two kinds of vessel collision: one is collision with the bridge girder due to insufficient vertical clearance and the other is collision with the pier column. From the results of bridge inspection, one of the problems identified with the Ayala Bridge is the collision with bridge girders.

The Study recommends the girder vessel prevention system for the Ayala Bridge as shown in **Figure 15.4-1**. The features with this system are as follows:

- The speaker automatically warns in case that the sensor detects an illegal navigational vessel (with cargo/vessel height greater than regulated),
- There is no possibility of damaging vessels,
- Installation costs for the system are considerably cheaper than physical protection measures, and
- Impairing landscape is to be minimized.

As far as the protection measures for the piers are concerned, the installation works may be set as a future issue because no damage due to vessel collisions was observed.

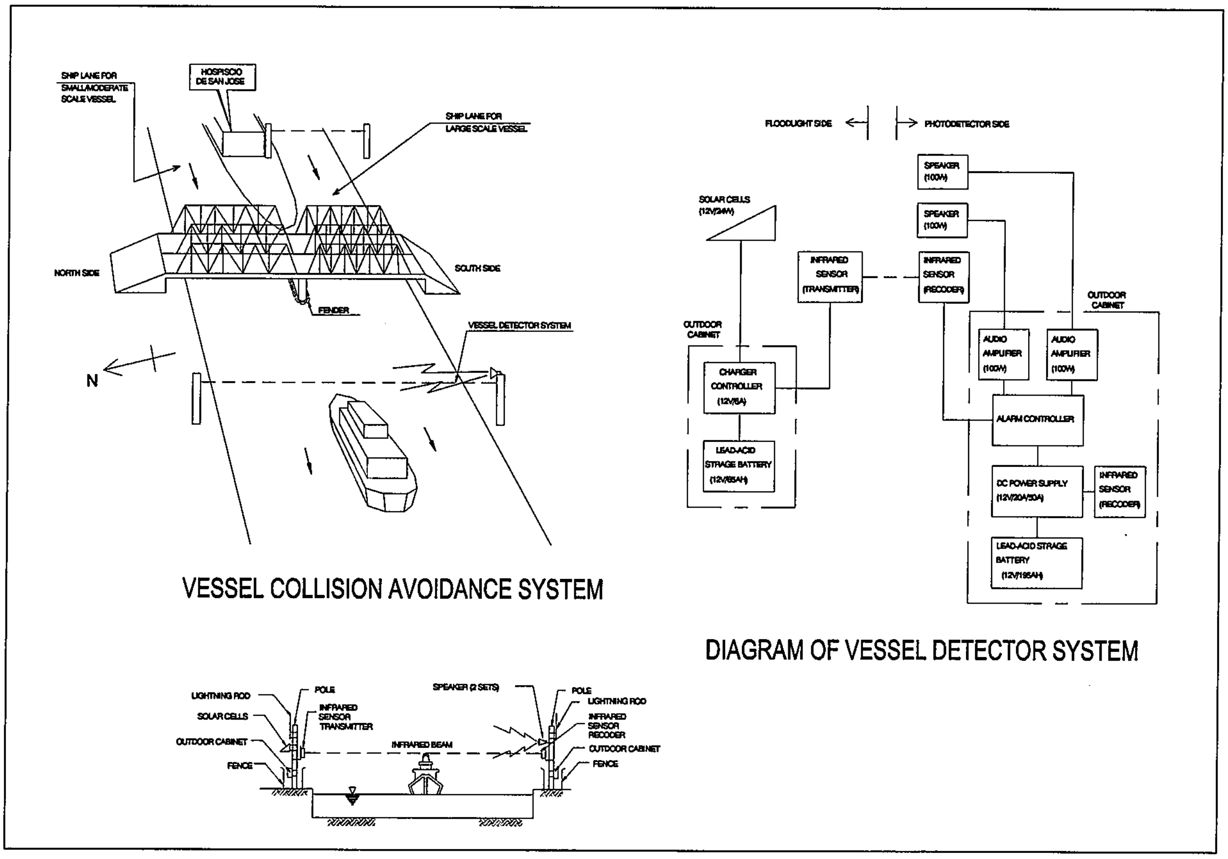



Figure 15.4-1 Vessel Collision Avoidance System

## 15.5 CONSTRUCTION PLAN AND TRAFFIC MANAGEMENT

### 15.5.1 Superstructure

#### (1) Construction Sequence

**Figure 15.5.1-1** shows the construction sequence of the improvement works for the downstream side.

**Step 1**

- Construction of one-way detour bridge (2-lane)
(To secure the existing 4-lane traffic and access road to the Hospicio)
- Utilization of existing east side 2-lane carriage way as opposite direction one-way detour.
- Installation of cofferdam for substructure construction
- Installation of temporary bents for the improvement works of superstructure
- Removal of sidewalk (down stream side)

**Step 2**

- Installation of bottom chord support girders at west and middle trusses
- Installation of a portal crane

**Step 3**

- Removal of concrete deck slab and floor system
- Removal of west side bottom chords

**Step 4**

- Installation of new bottom chords
- Removal of west side bottom chord support girder

**Step 5**

- Construction of new floor system (steel plate deck)
- Rechannelization of traffic

The sequence of the improvement works for the upstream side will be repeated as well.

#### (2) Construction Method for Steel Plate Deck

The replacement of lower chords will necessitate that the steel plate deck is self-supported. The design of floor system was conducted, accordingly, providing that the temporary bent acts as supporting points.

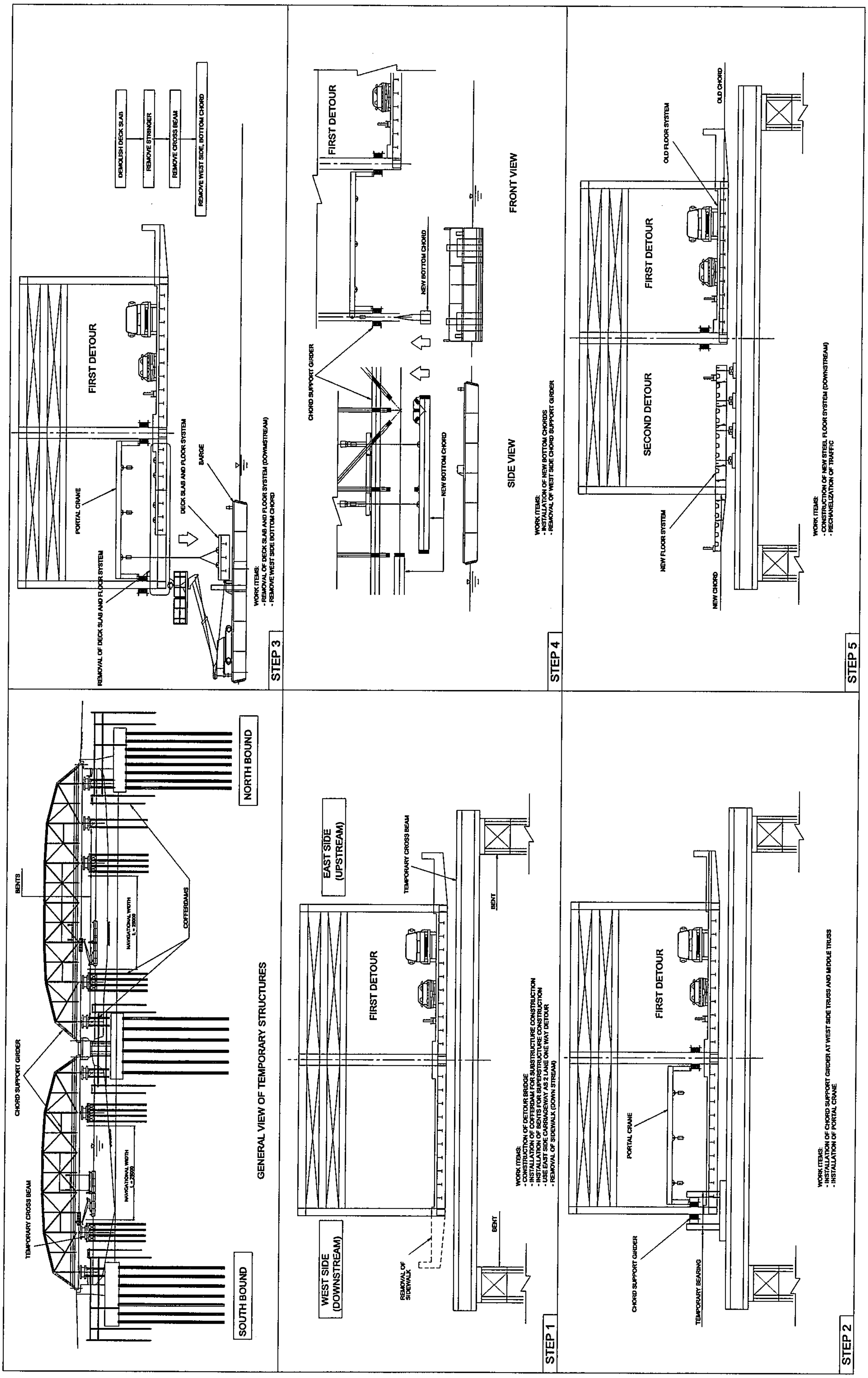



Figure 15.5.1-1 (1/2) Construction Sequence for West Side

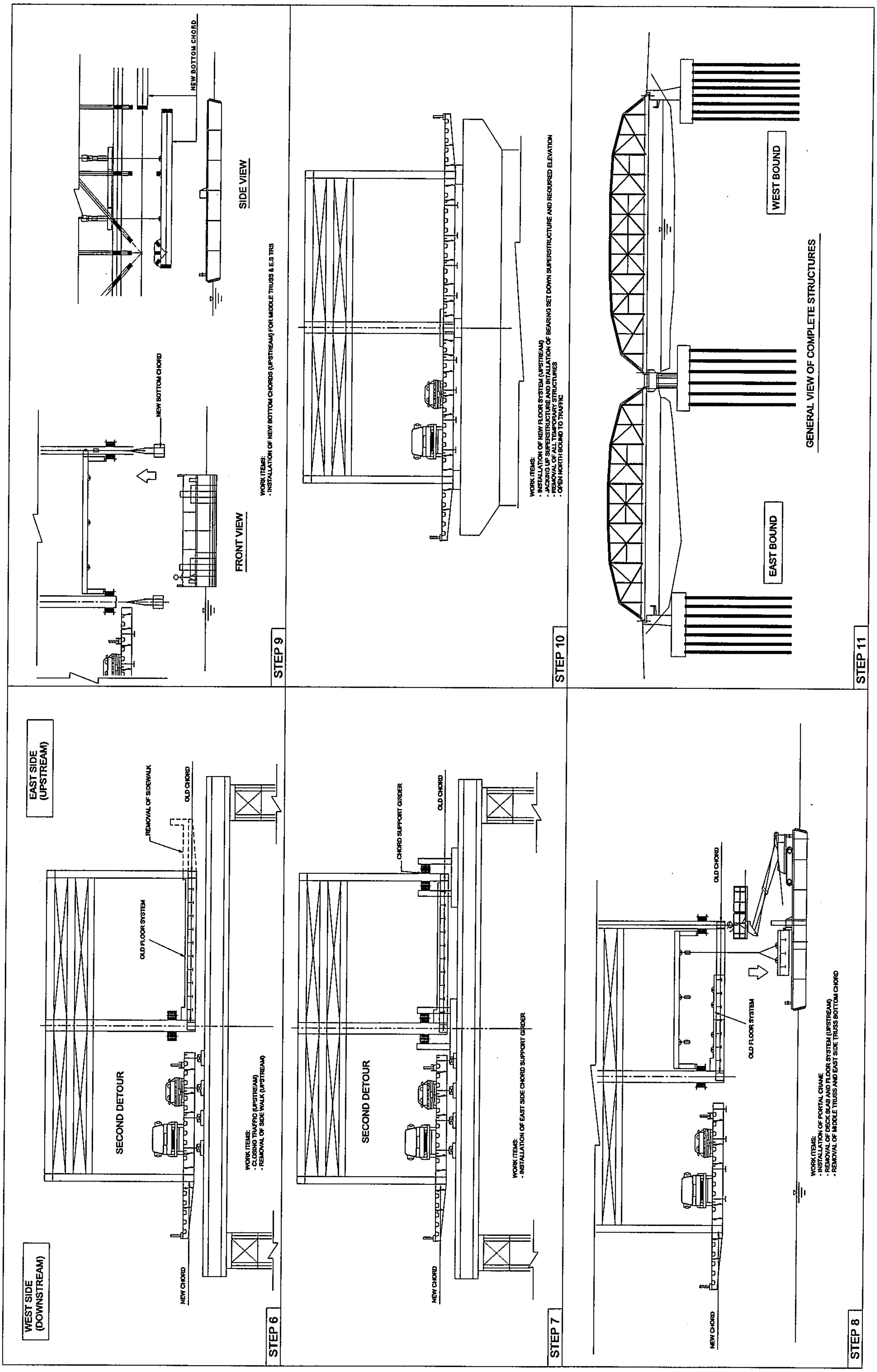



Figure 15.5.1-1 (2/2) Construction Sequence for West Side

The newly installed steel plated deck is expected to be a continuous structure with the temporary supports during construction. The dimensions of steel plate deck were studied in consideration of construction sequence.

#### (a) Study Procedure

The continuous bridge with steel plate deck was modified as a simple span bridge with a span length of 31.8 m, which length would retain the navigational width under construction. The allowable stress method was employed to determine the main dimensions of the steel plate deck.

The deflection due to live load of L/500 (L: Span Length) was deregulated to 1.2 times the allowable one, because the subject bridge had been modified as a simple span bridge.

#### (b) Determination of Main Dimensions

The main dimensions of steel deck plate are under construction shown in **Figure 15.5.1-2.**

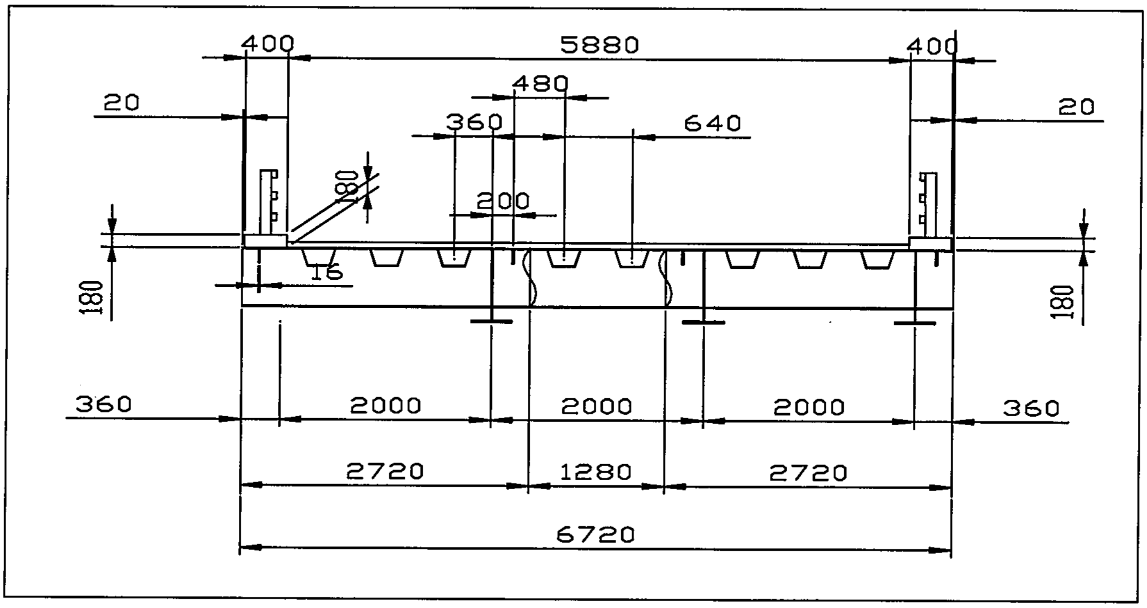



Figure 15.5.1-2 Main Dimensions of Steel Plate Deck under Construction

### (3) Primary Study on Erection Members

#### (a) Temporary Cross Beam

If the foundation of temporary support is constructed at the side of existing bridge because of difficulty of pilling works under the existing bridge, the span length of the temporary cross beam becomes 36 m. In order to make the span length shorter as much as possible, the sidewalk of existing bridge was planned to be removed to reduce the span length of the temporary beam to 30 m.

The temporary support is used for the following purposes:

- Support of the newly installed steel floor system
- Support of the existing bridge

The reaction from the existing bridge may be more heavier than that from newly installed floor system. The dimension of the temporary cross beam was thus studied in consideration of the heavier reaction. The distribution of dead and live loads in transverse direction of the bridge was considered. Half a total load was loaded to the middle truss and one forth were loaded to both outer main trusses. The allowable stress method was employed for the design calculation.

**Determination of Main Dimensions**

The temporary cross beam with a height of 1.0 m was applied so that it could be erected under the existing bridge. The cross beam with the box girder was proposed as shown in **Figure 15.5.1-3.**

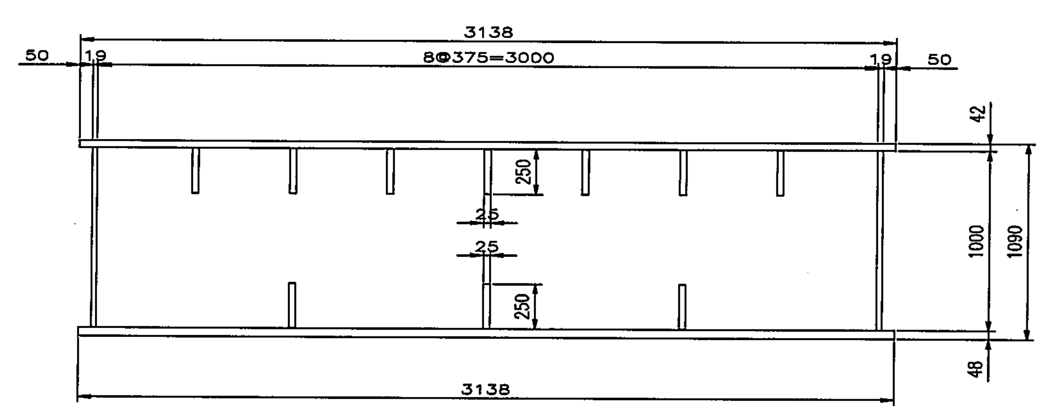



Figure 15.5.1-3 Main Dimensions of Temporary Cross Beam

### (b) Chord Support Girder

Chord support girders were applied in order to fix the main trusses during removal of the existing bottom chords, and these girders were planned to be utilized as the traveling crane track during replacement and installation of the floor system. **Figure 15.5.1-4** shows ideal drawing of utilization of traveling crane track.

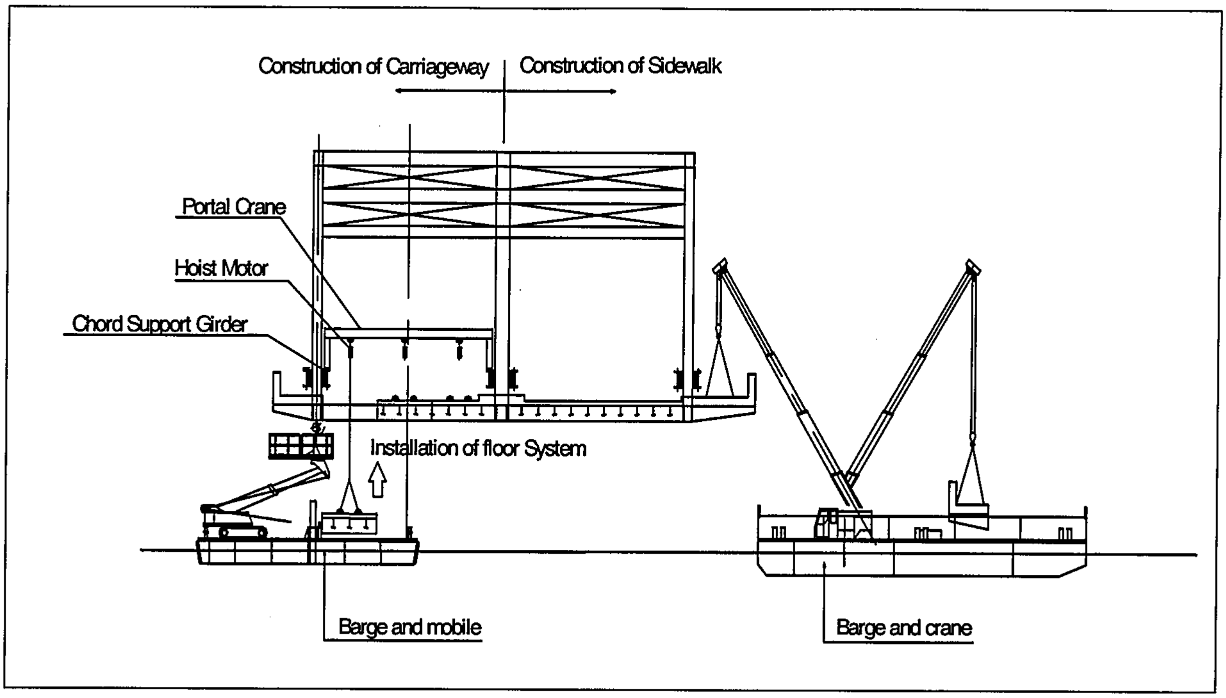



Figure 15.5.1-4 Utilization of Traveling Crane Truck

**Section Forces Acting upon Member**

The major section forces acting upon the chord support girders were assumed as follows:

- Axial force stemmed from the dead load of the main trusses between the temporary supports.
- Bending moment stemmed from traveling crane during replacement and installation of floor system.

The chord support girder was designed with the load of traveling crane, since the bending moment caused by traveling crane is more affected than the axial force caused by the dead load.

**Determination of Main Dimension**

As a result of study by allowable stress method, an H beam of 400 H-steel was applied.

### 15.5.2 Substructure

Construction Methodology shall satisfy two major considerations:

- Traffic – maintain Four (4) Lane traffic during construction:
- Navigation Clearance – 3.75 m for vertical clearance and 24m horizontal clearance.

Construction sequence for the improvement of Pier is shown in **Figure 15.5.2-1**. This method shall also be applied for both abutments.

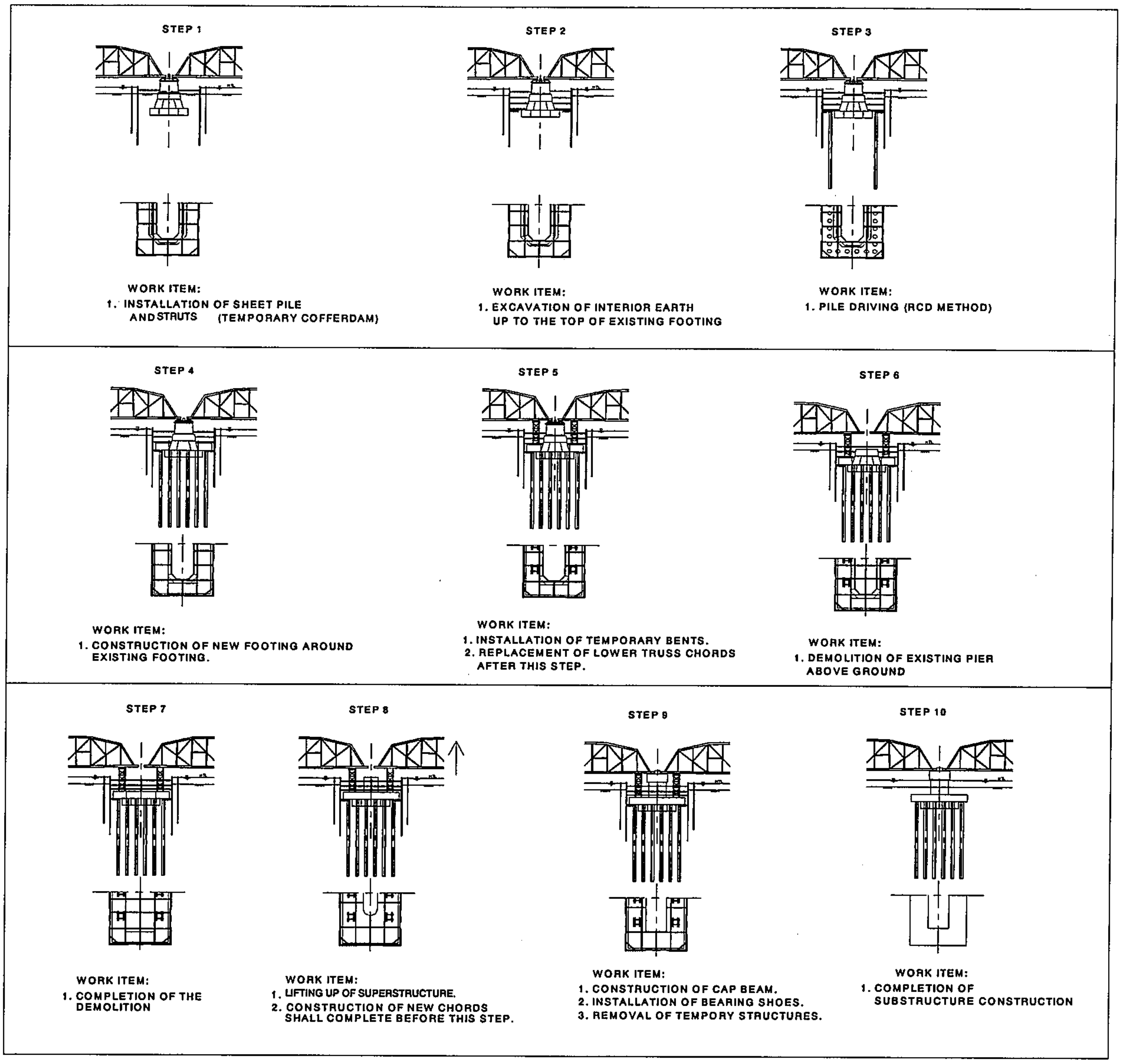



Figure 15.5.2-1 Construction Sequence of Substructure

### 15.5.3 Traffic Management Under Improvement Works

The basic policy on traffic management during improvement works is to secure the present traffic volume or four (4) lane carriage way. In the preliminary design two (2) lane detour bridge was proposed; the existing two (2) lane of the Ayala Bridge is to be utilized as the other two-lane carriage way. The verification of this traffic management plan was studied in this section, accordingly, by employing traffic flow analysis.

#### (1) Traffic Flow Analysis Cases

In order to verify traffic management plan under improvement works, the following cases were studied. (Refer to **Figure 15.5.3-1**).

- Case-1 : To secure the present four (4)-lane carriage way (Recommended Case)

- Case-2 : To provide only two (2)-lane carriage way
- Case-3 : To fully close the bridge to traffic

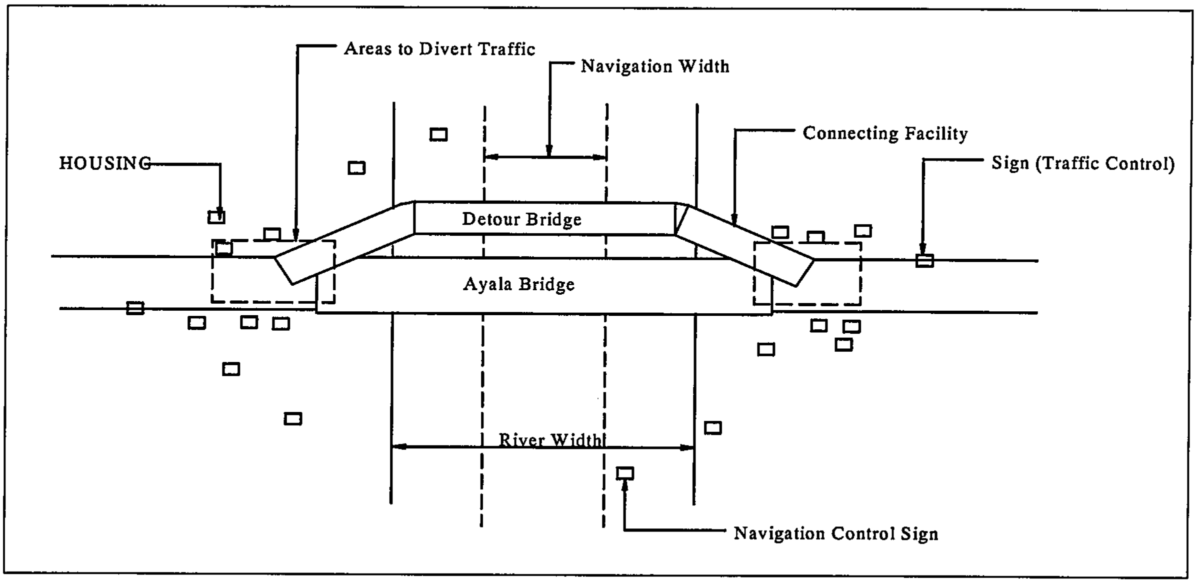



Figure 15.5.3-1 Traffic Management Plan under Improvement Works

## (2) Traffic Flow Analysis under Improvement Works

### (a) Analytical Year

Taking the implementation schedule into consideration, the analytical year of the traffic flow was set up in the year 2006.

### (b) Vehicle OD Traffic

The vehicle OD matrix in 2006 was estimated by interpolation method using OD matrix in 2002 and 2010.

### (c) Road Networks

The road networks incorporated in the alternative bridge plans was set up.

### (d) Traffic Assignment Method

The traffic assignment method was utilized for the STRADA Software of highway type incremental assignment.

## (3) Results of Traffic Demand Forecast

The results of forecasted traffic demand are shown in **Table 15.5.3-1,** which include traffic assignment of the bridges that are anticipated to be influenced by the traffic management under improvement works of the Ayala Bridge.

Table 15.5.3-1 Forecasted Traffic Assignment on Bridges in 2006

| | Bridge | Case 1 (4-lame) | Case 2 (2-lane) | Case 3 (Full Closure) | Case 2 – Case 1 | Case 3 – Case 1 |
|---|---|---|---|---|---|---|
| Downstream | Delpan Bridge | 70,489 | 70,608 | 70,303 | 119 | -186 |
| | Jones Bridge | 61,098 | 61,912 | 63,510 | 814 | **2,400** |
| ↑ | Mc Arthur Bridge | 49,675 | 55,168 | 70,196 | **5,493** | **20,521** |
| | Quezon Bridge | 87,100 | 92,400 | 100,500 | **5,300** | **13,400** |
| ↓ | Ayala Bridge | 46,300 | 33'400 | 0 | - | - |
| | Nagtahan Bridge | 91,500 | 92,900 | 100,100 | **1,400** | **8,600** |
| Upstream | Pandacan Bridge | 24,010 | 24,217 | 25,314 | 207 | **1,304** |
| | Lambingan Bridge | 34,727 | 34,441 | 34,283 | -286 | -444 |

The following are observed from the table.

- By full closure of the Ayala Bridge, five (5) bridges are considerably affected: Quezon Bridge, Mc Arthur Bridge and Jones Bridge crossing upstream side; Nagtahan Bridge and Pandacan Bridge crossing downstream side.
- In case of two (2)-lane provision (Case 2), three (3) bridges are affected: 5,300 PCU are diverted to Quezon Bridge, 5,493 PCU to Mc Arthur Bridge and 1,400 PCU to Nagtahan Bridge.
- The reason that traffic volume on the Mc Arthur Bridge is affected strongly is because present traffic volumes on both Quezon Bridge and Nagtahan Bridge adjacent to the Ayala Bridge are already beyond or equal to those capacities.
- Case 3 option will give adjacent bridges and areas rise to considerable traffic congestion.

## (4) Traffic Flow on the Ayala Bridge under Improvement Works

The predicted traffic volume in 2006 under improvement works is shown in **Table 15.5.3-1.** Based on the predicted traffic volume, the hourly variation of traffic volume on Ayala Bridge for the cases of 4-lane and 2-lane was estimated and shown in **Figure 15.5.3-2** and **15.5.3-3,** respectively.

The following can be judged from the figures:

- Provision of only two (2)-lane (Case 2) detour will bring about traffic congestion on the Ayala Bridge during the day time.
- In case of four (4)-lane provision (Case 1), the present traffic condition on the Ayala Bridge will be maintained.
- If Case 2 (2-lane) is chosen to save construction cost, heavy traffic congestion will be unavoidable.
- In consideration of traffic condition in the vicinity areas of the Ayala Bridge and access to Hospicio De San Jose, Case 1 is recommended and planned in the preliminary design.

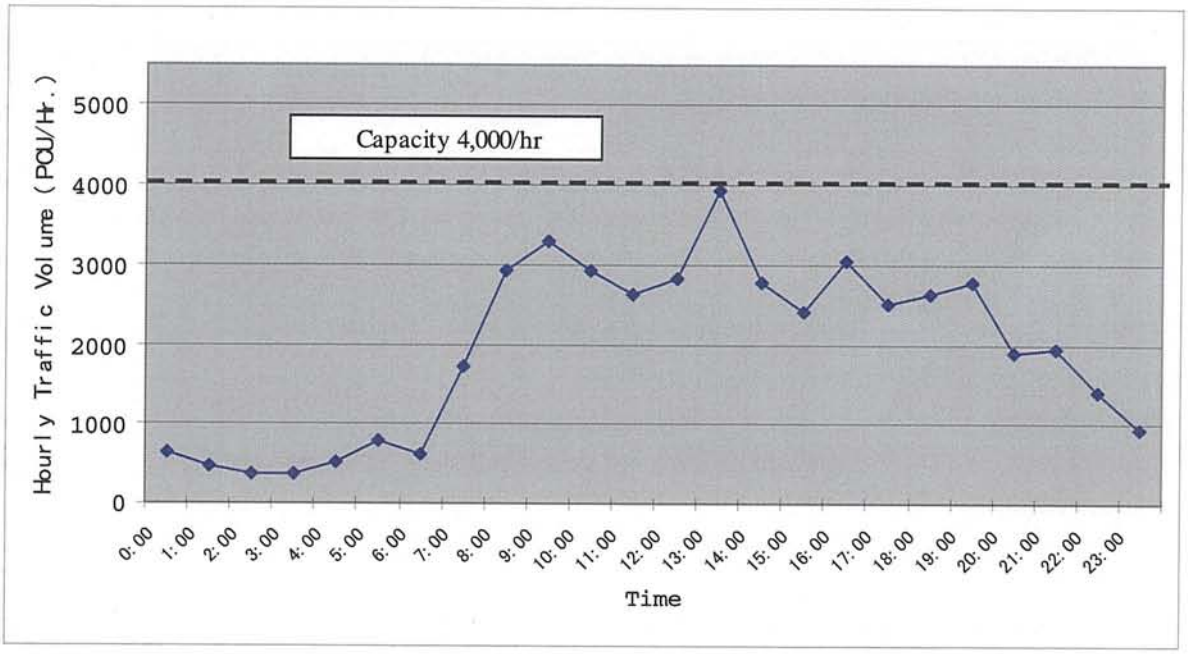



Figure 15.5.3-2 Hourly Variation of Traffic Volume on Ayala Bridge in 2006 for **Case 1**

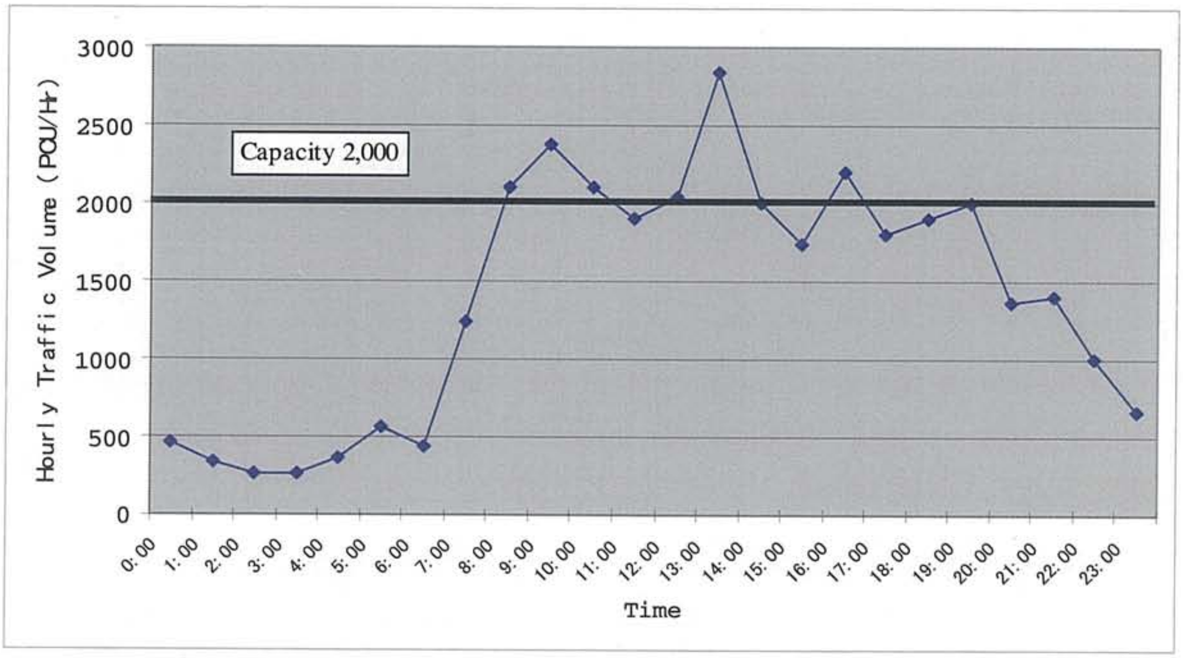
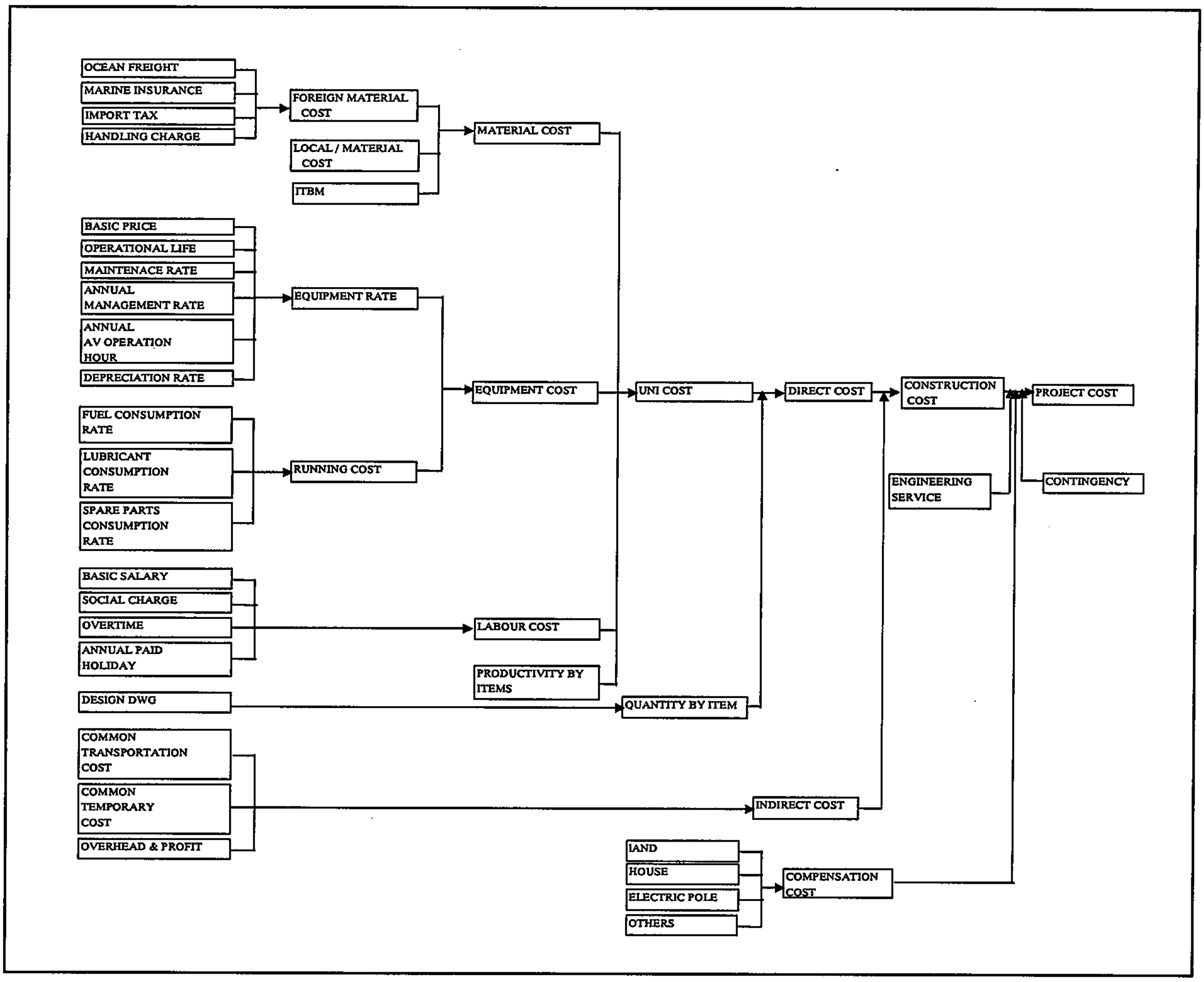



Figure 15.5.3-3 Hourly Variation of Traffic Volume on Ayala Bridge in 2006 for **Case 2**

## 15.6 PRELIMINARY COST ESTIMATE

The total project costs consist of total construction cost (civil works), land acquisition cost, and engineering service. The construction cost was estimated by accumulation of each work item cost which was the combination of labor costs, material costs and equipment costs considering the construction method and procedure.




**Cost Estimation Process**

The proportion of the total cost which is in foreign and local currency has been estimated based on the following principles.

| Foreign Currency | Local Currency |
|---|---|
| - Wages of foreign personnel<br>- Overhead and profits of foreign firms<br>- Imported equipment, materials and supplies<br>- Partial cost of domestic materials which include foreign component | - Wages of local personnel<br>- Overheads and profits of local firms<br>- Domestic equipment, materials and supplies.<br>- Taxes, etc |

To assist the economic evaluation of the project, cost portion of taxes and unskilled labor has also been estimated.

### 15.6.1 Construction Cost

The construction cost is estimated by accumulating the cost of each work item which is derived by multiplication of unit cost and quantity of each work item. The unit costs for each item are estimated from the combination of the basic unit prices of the labor wages, material prices and equipment operation cost considering the construction method and procedure.

The major items of basic prices for labor wages, material prices and equipment operation costs are shown in **Appendix 15.6.1-1.**

Quantities are estimated from the previous similar practices in Manila. In order to cover the unforeseen works and conditions at this moment, and considering the allowance of some changes in the detailed design stage, contingency of 5% was taken in account to the total construction cost.

The unit cost by construction item is shown in **Table 15.6.1-1**

Table 15.6.1-1 Unit Cost by Construction Items (1/2)

June 2003 Prices

| Item No. | Description | Unit | Unit Cost(PP) | Components (%) | | |
|---|---|---|---|---|---|---|
| | | | | Foreign | Local | Taxes |
| 1 | 2 | 3 | | | | |
| **PART A-FACILITIES FOR THE ENGINEER** | | | | | | |
| A-1.1 (a) | Combined Field Office and Laboratory Building (Rental Basis) | mo. | 84,000.00 | - | 100.0% | - |
| A-1.1 (b) | Furnishing of Furnitures, Fixtures and Appliances for Combined Field Office & Laboratory | ls | 762,770.00 | 30.0% | 60.0% | 10.0% |
| A-1.1 (c) | Operation and Maintenance of Combined Field Office and Laboratory | mo. | 33,125.00 | - | 98.0% | 2.0% |
| A-1.1 (d) | Furnishing of Equipment & Apparatus for Field Laboratory | ls | 1,138,402.00 | 75.0% | 10.0% | 15.0% |
| A-1.1 (e) | Operation and Maintenance of Field Laboratory (includes Lab. Technician/Aide/Clerk) | mo. | 46,082.03 | - | 95.0% | 5.0% |
| A-1.1 (f) | Consumable Stores | mo. | 24,000.00 | 30.0% | 60.0% | 10.0% |
| A-1.2 (a) | Field Engineers Living Quarter (Rental Basis) | mo. | 28,000.00 | - | 100.0% | - |
| A-1.2 (b) | Furnishing of Furnitures, Fixtures and Appliances for Living Quarters | ls | 278,600.00 | 30.0% | 60.0% | 10.0% |
| A-1.2 (c) | Operation and Maintenance of Field Living Quarters | mo. | 44,125.00 | - | 98.0% | 2.0% |
| A-1.3 | Provide, Operate and Maintain Three (4) units 4WD Pick-up Type, Double Crew Cab | Veh-mo. | 68,364.67 | 53.0% | 21.0% | 26.0% |
| A-1.4 | Provide/Operate/ Maintain Communication Facility for the Engineer | mo. | 27,950.00 | 71.0% | 11.0% | 18.0% |
| A-1.5 (a) | Furnishing of Surveying Instruments | ls | 152,500.00 | 41.0% | 23.0% | 36.0% |
| A1.5 (b) | Operation and Maintenance of Surveying Instruments | mo. | 28,015.35 | - | 95.0% | 5.0% |
| A-1.6 | Progress Photographs | set | 1,540.00 | 30.0% | 60.0% | 10.0% |
| **PART B- OTHER GENERAL REQUIREMENTS** | | | | | | |
| SPL 9 | Removal of Existing Structures/Buildings | l.s. | 66,550,000.00 | 62.0% | 17.0% | 21.0% |
| **PART C – EARTHWORKS** | | | | | | |
| 101(1) a | Removal of Existing Pier Shaft | c.u.m. | 493.26 | 62.0% | 17.0% | 21.0% |
| 101(1) b | Removal of Existing Abutment Shaft | c.u.m. | 362.80 | 62.0% | 17.0% | 21.0% |
| 101(!) c | Removal of Existing Timber Piles at Pier Foundation | each | 8,656.30 | 64.0% | 16.0% | 20.0% |
| 101(1) d | Removal of Existing Timber Piles at Abutment | each | 6,504.33 | 63.0% | 16.0% | 21.0% |
| 101(1) e | Removal of Existing PCCP | c.u.m. | 137.19 | 62.0% | 17.0% | 21.0% |
| 103(2) a | Bridge Excavation of Inside Cofferdam (Pier Foundation) | c.u.m. | 383.83 | 64.0% | 16.0% | 20.0% |
| 103(2) b | Bridge Excavation of Inside Cofferdam (Abutment) | c.u.m. | 303.94 | 65.0% | 14.0% | 21.0% |
| | | | | **Foreign** | **Local** | **Taxes** |
| 103(7) a | Structural Backfill for Pier Foundation | c.u.m. | 452.08 | 62.0% | 18.0% | 20.0% |
| 103(7) b | Structural Backfill for Abutment | c.u.m | 161.06 | 59.0% | 20.0% | 21.0% |
| **PART D- SUBBASE AND BASE COURSE** | | | | | | |
| 200 | Aggregate Subbase Course | c.u.m. | 372.71 | 34.0% | 50.0% | 16.0% |
| 202 | Aggregate Base Course | c.u.m. | 602.44 | 45.0% | 37.0% | 18.0% |

Table 15.6.1-1 Unit Cost by Construction Items (2/2)

June 2003 Prices

| Item No. | Description | Unit | Unit Cost(PP) | Components (%) | | |
|---|---|---|---|---|---|---|
| | | | | Foreign | Local | Taxes |
| **PART E- SURFACE COURSE** | | | | | | |
| **Carriageway** | | | | | | |
| SPL 3(2)a | Blast Cleaning Deck Plate | Sq.m. | 148.39 | 33.0% | 53.0% | 14.0% |
| SPL 3(2)b | Waterproofing | Sq.m. | 80.03 | 58.0% | 16.0% | 26.0% |
| SPL 3(3) | Bituminous Tack Coat | tonne | 27,602.76 | 76.0% | 3.0% | 21.0% |
| SPL 3(4) | Bituminous Binder Course on Steel Bridge Deck Slab (40 mm thk) | tonne | 8,109.45 | 65.0% | 12.0% | 23.0% |
| SPL 3(5) | Improved Bituminous Surface Course (T=40 mm) | tonne | 6,120.99 | 63.0% | 17.0% | 20.0% |
| **Walkway** | | | | | | |
| SPL 3(2)a | Blast Cleaning Deck Plate | Sq.m. | 148.39 | 33.0% | 53.0% | 14.0% |
| SPL 3(2)b | Waterproofing | Sq.m. | 80.03 | 58.0% | 16.0% | 26.0% |
| SPL 3(5) | Bituminous Binder Course on Steel Bridge Deck Slab (40 mm thk) | tonne | 8,109.45 | 65.0% | 12.0% | 23.0% |
| **Approach Slab** | | | | | | |
| 311(1) | Portland Cement Conc. Pavement (230 mm) | Sq.m. | 800.80 | 40.0 | 45.0 | 15.0 |
| SPL 4(1) | Removal of Existing Deck Slab | ls | 12,669,659.28 | 64.0% | 19.0% | 17.0% |
| **PART F-BRIDGE CONSTRUCTION** | | | | | | |
| ***SUPERSTRUCTURE*** | | | | | | |
| SPL 4(2) | Removal of Existing Bottom Chord | ls | 6,349,745.62 | 64.0% | 19.0% | 17.0% |
| SPL 4(3) | Temporary Works | ls | 50,578,000.0 0 | 64.0% | 7.0% | 29.0% |
| SPL 4(4) | Erection of Structural Steel Girder | kg | 277.31 | 84.0% | 5.0% | 11.0% |
| SPL 4(5) | Expansion Joint | ls | 26,620,000.00 | 64.0% | 7.0% | 29.0% |
| ***SUBSTRUCTURE*** | | | | | | |
| 400(22) | Precast Concrete Piles (400x400) furnished and Driven | l.m. | 3,833.73 | 53.0% | 30.0% | 17.0% |
| 400(23)a | Test Piles (400x400) Furnished and Driven | l.m. | 4,511.56 | 55.0% | 28.0% | 17.0% |
| 400(7)a | Tubular Steel Piles (ø1000mm x 25mm), Furnished | l.m. | 32,131.23 | 85.0% | 4.0% | 11.0% |
| 400(11)a | Tubular Steel Piles (ø1000mm x 25mm), Driven @ Pier | l.m. | 3,551.44 | 64.0% | 16.0% | 20.0% |
| 400(11)b | Tubular Steel Piles (ø1000mm x 25mm),Driven @ Abutment | l.m. | 3,240.96 | 64.0% | 16.0% | 20.0% |
| 400(23)b | Test Pile, Tubular Steel (ø1000mm x 25mm), Furnished & Driven | l.m. | 37,121.91 | 82.0% | 6.0% | 12.0% |
| 404(1) | Reinforcing Steel, Grade 40 | kgs. | 49.32 | 57.0% | 28.0% | 15.0% |
| 404(1)b | Structural Concrete Class "A" (Substructure) | c.u.m | 5,821.65 | 45.0% | 38.0% | 17.0% |
| 405(6) | Structural Concrete Class "B" (Lean Concrete) | c.u.m | 3,347.44 | 43.0% | 40.0% | 17.0% |
| SPL1(1) | Temporary Steel Guide Frame | l.s. | 5,592,427.26 | 69.0% | 14.0% | 17.0% |
| SPL(414) | Temporary Cofferdam | l.s. | 86,446,187.41 | 69.0% | 10.0% | 21.0% |
| | **Total of Part F** | | | | | |
| **PART G- DRAINAGE** | | | | | | |
| SPL 4(4)a | Deck Drainage Pipe, (150 mm dia @ 2.5) w/ Fixing Bracket | ea | 2,142.32 | 27.0% | 60.0% | 13.0% |
| 504(5) | Grouted Riprap (Gravity Wall) | c.u.m. | 2,163.51 | 25.0% | 62.0% | 13.0% |
| 505 | Stone Masonry | c.u.m. | 2,686.61 | 28.0% | 59.0% | 13.0% |
| 507c | Steel Sheet Pile w/ Conc. Pile cap | l.m. | 177,455.46 | 82.0% | 7.0% | 11.0% |
| **PART H- MISCELLANEOUS** | | | | | | |
| 603(3)a | Concrete Curbs including of Formwork and Falsework | l.m. | 1,272.33 | 25.0% | 62.0% | 13.0% |
| 606(1) | Pavement Markings (Reflective) | Sq.m. | 689.79 | 28.0% | 59.0% | 13.0% |
| SPL 5(1)a | Steel Railing | l.m. | 14,791.83 | 82.0% | 7.0% | 11.0% |
| SPL 5(2)a | Illumination System, Approach Bridge | LS | 3,524.234.19 | 49.0% | 29.0% | 22.0% |
| SPL5(3) | Navigation Light | l.s. | 9,800,215.64 | 63.0% | 8.0% | 29.0% |
| SPL5(4) | Floating Fender | l.m. | **72,019.16** | 63.0% | 9.0% | 28.0% |
| **PART I- PROVISIONAL SUM** | | | | | | |
| SPL 6 | Temporary Detour Bridge (Ayala Bridge) | l.s. | **22,270,218.17** | 84.0% | 5.0% | 11.0% |
| SPL 7 | Temporary Detour Bridge (Hospico de San Jose Access) | l.s. | **5,575,908.67** | 84.0% | 5.0% | 11.0% |
| SPL 8 | Permanent Detour Bridge to Hospicio de San Jose | l.s. | **6,552.484.62** | 84.0% | 5.0% | 11.0% |
| **PART J- CONTINGENCY** | | | | | | |
| SPL 10 | Contingency (5% of total Direct Cost) | l.s. | **50,062,103.91** | 75.0% | 15.0% | 10.0% |

Detailed computation is presented in **Appendix 15.6.1-2.**

## Total Construction Cost

The total construction cost for the bridge estimated on the basis described above is shown in **Table 15.6.1-2.**

Table 15.6.1-2 Estimated Construction Cost

June, 2003 Prices

| Items | | Cost( x MP) |
|---|---|---|
| Superstructure | Foreign | 372.37 |
| | Local | 31.04 |
| | Tax | 67.69 |
| | Subtotal | 471.09 |
| Substructure | Foreign | 290.99 |
| | Local | 70.88 |
| | Tax | 68.29 |
| | Subtotal | 430.16 |
| Highway | Foreign | 9.47 |
| | Local | 4.68 |
| | Tax | 2.72 |
| | Subtotal | 16.87 |
| Detour | Foreign | 70.76 |
| | Local | 14.31 |
| | Tax | 18.09 |
| | Subtotal | 103.16 |
| **Total Construction Cost** | | **1,021.28 MP** |

## 15.6.2 Road Right-Of-Way Acquisition Cost

### (1) Unit Price

Unit prices for road right-of-way acquisition and compensation were obtained from City Assessors' Office in Manila. **Table 15.6.2-1** shows the summary of information obtained, including the names of barangay, the existing land use or zoning in the area, and the price of land (per square meter) based on tax declaration. **Table 15.6.2-2** on the other hand presents the type of structures, and the price of improvement/structure (per square meter).

Table 15.6.2-1 Land Valuation of Area along Ayala Bridge (Based on Tax Declaration)

| City/Bridge | Barangay | Location (Street/Avenue) | Land Use/Zoning | Price (Peso/sq.m) | Year |
|---|---|---|---|---|---|
| Manila/Ayala Bridge | Ermita | Ayala Blvd. to Taft Avenue | 4th Class Commercial | 12,800 | As of 1996 |
| | San Miguel | P. Casal (From Gen. Solano) | 4th Class Commercial | 7,800 | As of 1996 |

Table 15.6.2-2 Valuation of Improvements along Ayala Bridge

| City/ Municipality | Location / Barangay | Type of Structure | Price (Peso per square meter) | | Year |
|---|---|---|---|---|---|
| | | | Upper Limit | Lower Limit | |
| Manila/Ayala Bridge | Ermita | Office Bldg. (PLDT) | 9,400 | 5.700 | As of 1996 |
| | | Robert Bright Warehouses Commercial/Res. Area | 5,800<br>11,000 | 2,200<br>7,300 | As of 1996 |
| | San Miguel | Office Bldg. (Gov't Office-Dep't of Budget) | 9,400 | 5,700 | As of 1996 |
| | | Industrial Bldg.(Elite Auto Shop) | 6,800 | 3,200 | As of 1996 |
| | | Office Bldg. (Don Mariano Bldg.Universal Mills Corp.) | 9,400 | 5,700 | As of 1996 |
| Manila/Ayala Bridge | San Miguel | Warehouse (Jet M Gas) | 5,800 | 2,200 | As of 1996 |
| | | None (Vacant Lot) | 4,800 | 2.000 | As of 1996 |
| | | Industrial Bldg. (Sinophil Phil. Inc.) | 6,800 | 3,200 | As of 1996 |
| | | Commercial/ Residential Bldg | 11,000 | 7,300 | As of 1996 |
| | | Office Bldg. (A&I Bldg.) | 9,400 | 5,700 | As of 1996 |

### (2) Road Right-of-Way Acquisition and Compensation Cost

Land areas to be acquired/rented, present land uses and number of structures affected, etc. were determined based on the topographic maps illustrated in **Appendix 15.6.2-1**

## 15.6.3 Engineering Cost

Engineering service cost consists of the engineering design services at the detailed design stage and the construction supervision at the construction stage. The engineering service cost vary depending on the scales of the project, tender processing and contract method.

Based on previous experiences, the engineering service costs for the project are estimated as 5% and 8% of the total construction cost for the detailed design and construction supervision respectively.

The estimated engineering cost is shown in **Table 15.6.3-1**

Table 15.6.3-1 Estimated Engineering Cost

June, 2003 Prices

| Items | | Cost (x MP) |
|---|---|---|
| Detailed Design | Foreign | 22.47 |
| | Local | 14.30 |
| | Tax | 4.08 |
| | Subtotal | 40.85 |
| Construction Supervision | Foreign | 44.93 |
| | Local | 28.60 |
| | Tax | 8.17 |
| | Subtotal | 81.70 |
| **Total Engineering Cost** | **Total** | **122.55** |

## 15.6.4 Project Cost

The total project cost consists of construction cost, land acquisition cost and engineering service cost. The summary of the estimated project cost is given in **Table 15.6.4-1**

Table 15.6.4-1 Summary of Estimated Project Cost

June, 2003 Prices

| Items | | Cost (x Mp) |
|---|---|---|
| Construction Cost | Foreign<br>Local<br>Tax | 781.10<br>128.40<br>161.80 |
| | Subtotal | 1,071.30 |
| Engineering Cost | Foreign<br>Local<br>Tax | 67.40<br>42.90<br>12.30 |
| | Subtotal | 122.60 |
| Land Acquisition Cost | Foreign<br>Local<br>Tax | -<br>56.60<br>6.40 |
| | Subtotal | 63.00 |
| Grand Total | Foreign<br>Local<br>Tax | 848.50<br>227.90<br>180.50 |
| **Grand Total** | | **1,256.90** |

## 15.7 MAINTENANCE PLAN

The main objectives of road maintenance are:

- To provide comfortable, safe, efficient and reliable facilities to users, and
- To prevent prematured deterioration and prolong the life of road structures, thus protecting road facilities from costly rehabilitation/strengthening or reconstruction.

Present maintenance system and its practice were described in **Chapter 3.**

This chapter covers the maintenance requirements for the Ayala Bridge.

### 15.7.1 Budgetary Consideration

As described in Chapter 3, the budget allocation for maintenance requirement is based on the EMK system. The allocation of the budget for NCR in CY 2002, which is responsible for the maintenance and operation of bridges in Metro Manila area, is as follows: (refer to **Section 3.3**)

- EMK for road s and bridges = ₱ 2,598.334 EMK
- Basic Cost = ₱ 60,644 / EMK
- Estimated budget allocation = ₱ 157,575,000

On the other hand, the maintenance and operation costs required for the Ayala Bridge was estimated to be about 4.7 million Pesos for adequate maintenance activities, which is presumed to be 0.3% of new construction cost. In light of the present budget allocation, the budget is considerably short on the cost required for adequate maintenance activities.

### 15.7.2 Recommendation

The following are recommended in consideration of the present budget allocation system and the situation of Ayala Bridge.

- To allocate budget for the Ayala Bridge to the extent praticable considering its specialty and characteristics, which is listed as a historical structure and expected to be located in the possible tourist-oriented area.
- To expect such company as Ayala Foundation to burden or donate a part of maintenance cost.
- To incorporate maintenance activities for the Ayala Bridge into that for the linear park being conducted by PRRC, or to share the cost between DPWH and PRRC.

Beauty and aesthetic of the bridge are determined not only from the design but from adequate routine and periodical maintenance activities.

It is vital, for maintaining the historical value and beauty of the Ayala Bridge, that adequate routine and periodical maintenance activities be constantly conducted.