19.3 PRELIMINARY DESIGN AND COST ESTIMATES

19.3.1 Preliminary Design of Bridge

(1) Design Criteria

Design criteria for material and load and geological condition are shown in **Table 19.3.1-1** and **Figure 19.3.1-1**, respectively.

Table 19.3.1-1 Design Criteria

I. SPECIFICATION	- AASHTO Standard Specification for Highway Bridges, 16th Edition 2000 including Division IA, Seismic Design - Specification for Highway Bridges, Japan Road Association, 1994
II. MATERIAL	- CONCRETE; Reinforced Concrete (Pile Cap & Pile) fc' = 28 MPa Reinforced Concrete (Pile Wall) fc' = 21 MPa Prestressed Concrete (Superstructure) fc' = 41 MPa - Reinforcing Steel; fy = 415 MPa - Prestressing Steel; fu = 1860 MPa - Structural Steel, 248 MPa A36 (36,000psi)
III. LOADS	- Deadloads Reinforced Concrete = 24 kN/cu.m Steel = 77 kN/cu.m Earth Compacted = 19 kN/cu.m - Highway Loads AASHTO MS – 18 Loading - Impact Loads I = 15.24/L + 38, Where L = Length in meters - Sidewalk Loads For Span more than 20m Sidewalk Loading shall be 2.50 KPa - Earthpressure Mononobe – Okabe Method - Seismic Load Division I-A, AASHTO with A = 0.4

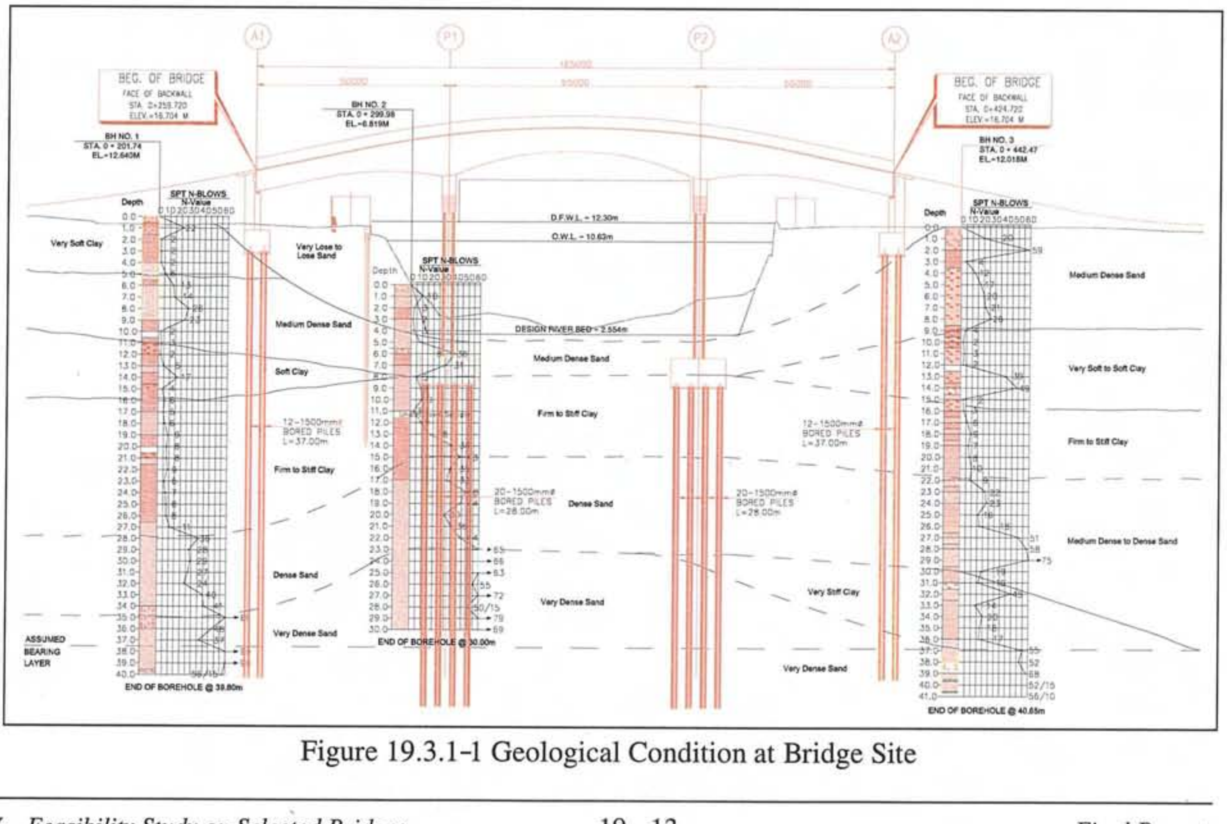


Figure 19.3.1-1 Geological Condition at Bridge Site

(2) Determination of Main Dimensions

(a) Superstructure

The center span length is set at 65 meters to maintain an ideal navigational width of 60 meters. Also, the soffit at any portion of the bridge satisfies the required navigational clearance. Side span length of 50 meters was determined from the ratio of 1.0 to 1.3 of side span and center span. The total bridge length is 165 meters as shown in **Figure 19.3.1-2**.

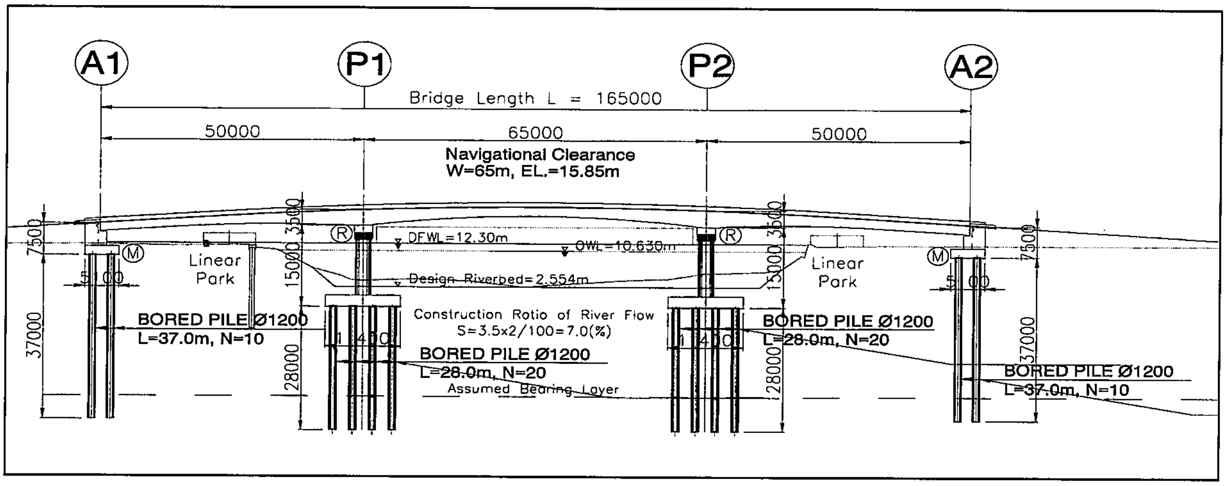


Figure 19.3.1-2 Side View of the Bridge

Main dimensions of prestressed concrete box girder are studied based on the previous projects. Three-cell box girder type of section was recommended since the width of bridge is 20 meters (See **Figure 19.3.1-3**) and one of the side spans is curved.

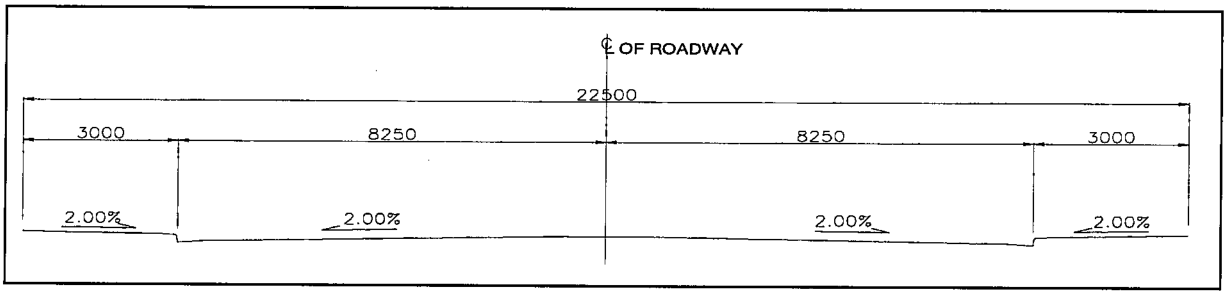


Figure 19.3.1-3 Typical Cross Section for the Study

Typical cross section of superstructures is shown in **Figure 19.3.1-4**. The adopted dimension of superstructure is shown in **Table 19.3.1-2**

Table 19.3.1-2 Main Dimension of Superstructure

	Recommended	Adopted
Bridge Type	3-span continuous prestressed concrete box girder bridge	
Bridge Length L	L = 50+65+50 = 165 m	
Ls : Lc : Ls	1.0:1.3:1.0 (0.75:1.00:0.75)	ditto
Girder Height (Bridge Pier)	Lc/15 to Lc/22	3.5 m (Lc/18.6)
Girder Height (Span Center)	Lc/30 to Lc/45	1.8 m (Lc/36.1)

Ls : Side Span Length
Lc : Center Span Length

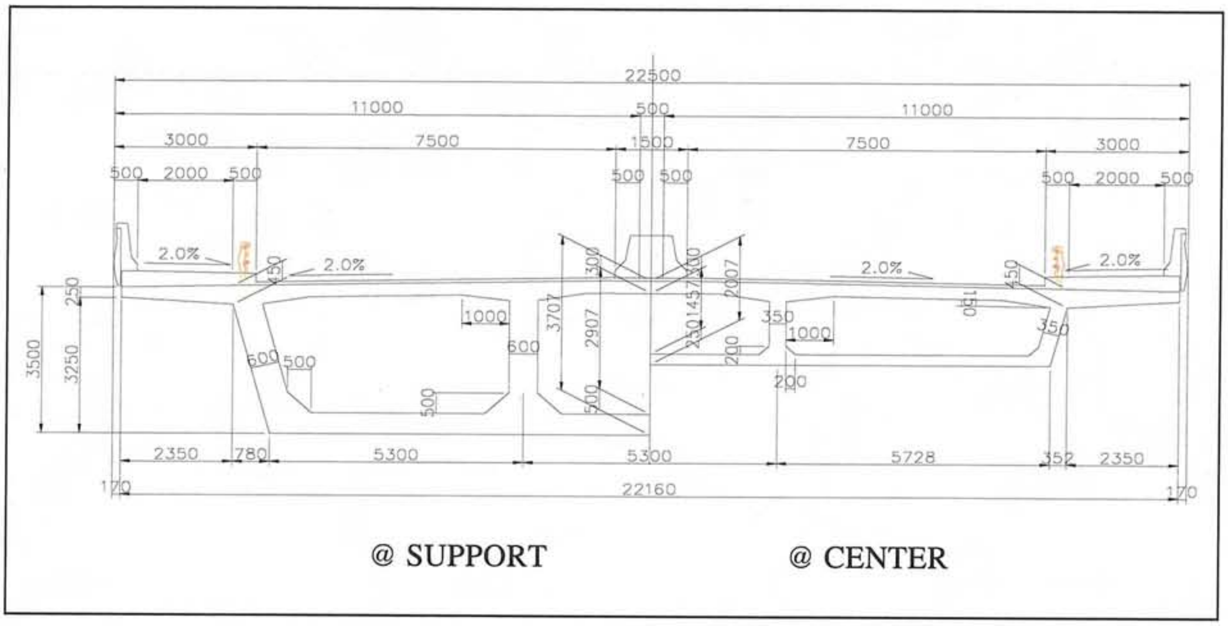


Figure 19.3.1-4 Cross Section of PC Box Girder

(3) Superstructures

(a) Comparison of Substructure Type

The substructure type for the newly constructed bridge pier was determined based on the comparative study on other alternatives using the cast-in-place concrete pile type foundation or steel pipe well type foundation. **Table 19.3.1-3** shows the comparison of substructure type. The cast-in-place concrete piles type foundation was selected for the bridge pier since the construction cost is lower than the steel pipe well type foundation. The lengths of the cast-in-place concrete piles were determined based on the structural and geo-technical analysis. The wall type main pier was adopted to minimize disruption of river flow.

For the abutment, the cast-in-place concrete pile type foundation was adopted. From the viewpoint of the stability of the river embankment, the reversed T-type abutment was judged to be preferred to the pile bent type or monolithic abutment.

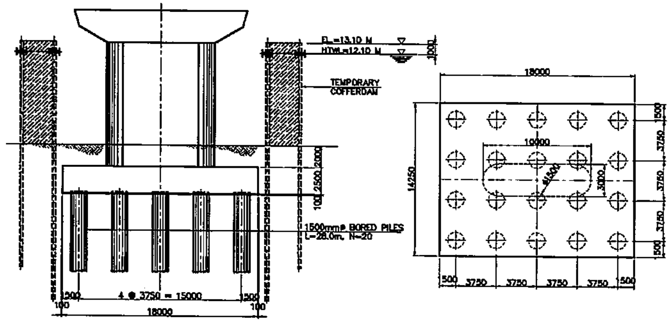
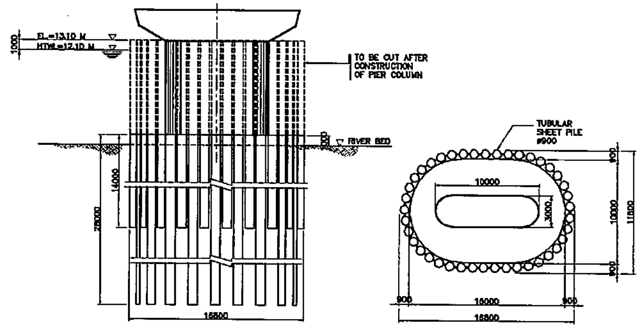
(b) Main Dimension of Substructure

<u>Main Pier</u>

Wall type bridge pier with cast-in-place concrete bored pile was employed. The direction of bridge pier is parallel with river flow. The top of the footing was planned more than 2.0 meters below from design riverbed.

The structural drawing of main pier is shown in **Figure 19.3.1-5**.

Table 19.3.1-3 Comparison of Substructure Type

	ALTERNATIVE 1		ALTERNATIVE 2	
ELEVATION / PLAN				
GENERAL DESCRIPTION	• WALL TYPE PIER ON BORED PILE FOUNDATION.		• WALL TYPE PIER ON TUBULAR STEEL PILES (CAISSON) FOUNDATION.	
SUBSTRUCTURE COST	• MULTIPLE PILE FOUNDATION IS CHEAPER REQUIRING LESSER MATERIAL QUALITY. • THIS FOUNDATION TYPES REQUIRES TEMPORARY COFFERDAM AND JETTY WHICH IS VERY COSTLY. • STRUCTURE COST = 83.60M TEMP. JETTY/COFFERDAM COST = 51.60M TOTAL = ₱135.20 M	A	• QUALITY OF MATERIALS FOR THIS FOUNDATION TYPE IS GREATER HENCE COSTLIER. • TUBULAR SHEET PILE REMAINS AS PART OF THE CAISSON FOUNDATION THUS ENTAILS SAVINGS. • STRUCTURE COST = 121.30M TEMP. JETTY/COFFERDAM COST = 39.20M TOTAL = ₱160.50M	C
CONSTRUCTABILITY	• TEMPORARY COFFERDAM AND JETTY IS NEEDED PRIOR TO CONSTRUCTION OF THE FOUNDATION. • PILE BORING BELOW RIVER IS SUSCEPTIBLE TO EXCAVATION COLLAPSE AND PILE DECKING. • TEMPORARY STEEL CASING AND MUD SLURRY REQUIRE TO PREVENT COLLAPSE OF SOIL. • LARGE DIAMETER BORED PILES RELATIVELY HARDER TO DRILL	B	• INTERLOCKED TUBULAR STEEL PILES SERVE AS A PROTECTIVE WALL DURING CONSTRUCTION OF FOUNDATION. • CONSTRUCTION PROCEDURE IS RARELY DONE BY LOCAL CONTRACTORS. • PILE SPLICING NEEDED IF ADEQUATE BEARING IS AT GREATER DEPTH.	A
CONSTRUCTION DURATION	• CONSTRUCTION PERIOD FOR TWO PIERS 5 MOS.	B	• CONSTRUCTING PERIOD FOR TWO PIERS 4 MOS.	A
STRUCTURAL ASPECT	• SUBSTRUCTURE IS MORE FLEXIBLE DUE TO LONGER COLUMNS AND MORE SLENDER PILES. • SEISMIC FORCE DEMAND ON FOUNDATION IS SLIGTHLY LESSER. • LOAD AND INTEGRITY TESTING NECESSARY TO CONFRIM ASSUMED PILE CAPACITY.	A	• PIER WALL OVER CAISSON FOUNDATION MAKES THE SUBSTRUCTURE VERY RIGID, RESULTING TO SHORTER PERIOD OF VIBRATION. • DEMANDS LARGER SEISMIC FORCE ON THE FOUNDATION. • PILE DRIVEN TO REFUSAL TO ASSURE ADEQUATE BEARING REQUIREMENT. • EXERTS LARGE FORCES ON THE CONFINING SUB-STRATA.	C
RIVER HYDRAULICS	• ENROACHMENT ON RIVER SECTION DURING CONSTRUCTION 43.80% • ENROACHMENT ON RIVER SECTION AFTER CONSTRUCTION 6.00%	B	• ENROACHMENT ON RIVER SECTION DURING CONSTRUCTION 23.60% • ENROACHMENT ON RIVER SECTION AFTER CONSTRUCTION 6.00%	A
NAVIGATIONAL CLEARANCE	• NAVIGATIONAL CLEARANCE DURING CONSTRUCTION 30.45m • NAVIGATIONAL CLEARANCE AFTER CONSTRUCTION 60.00M	B	• NAVIGATIONAL CLEARANCE DURING CONSTRUCTION 51.20M • NAVIGATIONAL CLEARANCE AFTER CONSTRUCTION 60.00M	A
RECOMMENDATION	• RECOMMENDED	A	• NOT RECOMMENDED	B
NOTE	(A) – GOOD		(B) – MEDIUM (C) – NOT GOOD	

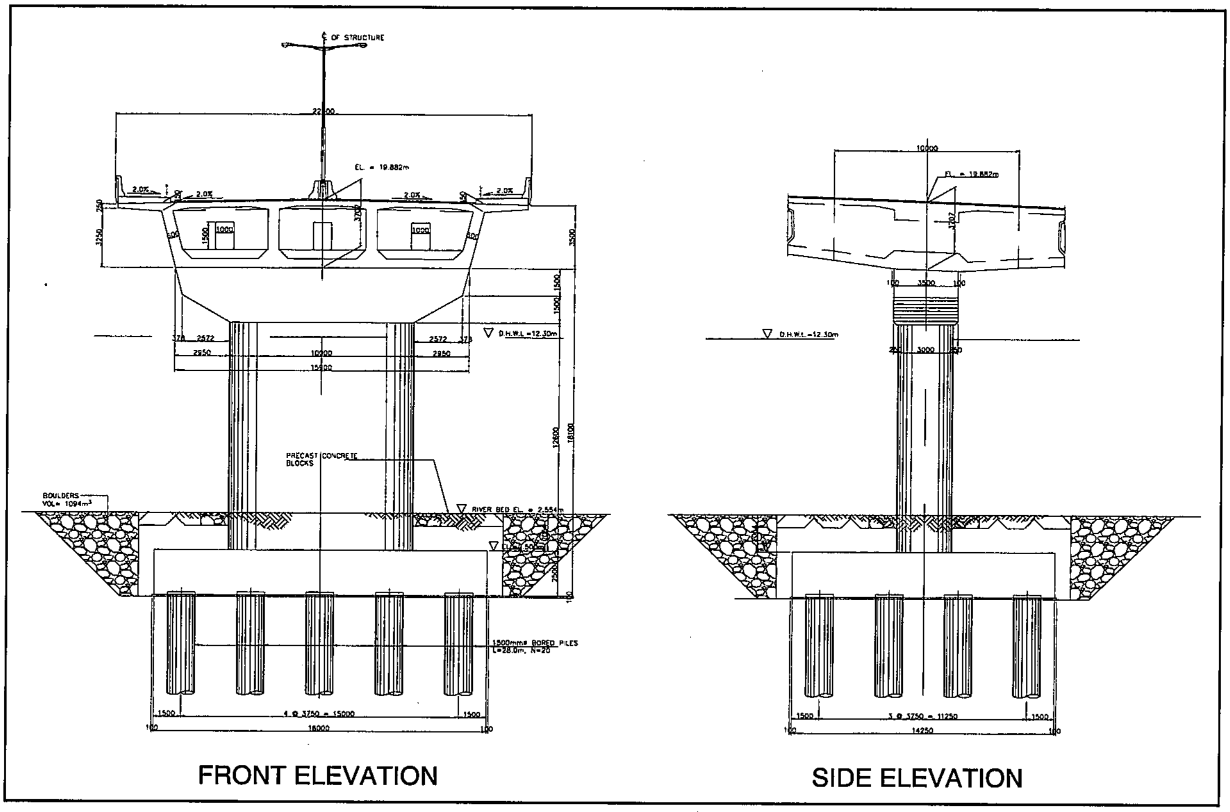


Figure 19.3.1-5 Structural Drawing of Main Pier

Abutment

The location of abutment was determined from appropriate bridge length. A vertical clearance of 3.0m or more between linear park and the bridge is retained based on the requirements of PRRC.

Reversed T type abutment with cast-in-place concrete bored pile was adopted. The orientation of abutment is orthogonal with the superstructure. The top of footing was planned to be constructed more than 0.5 meters below design ground level.

Detailed structural drawings are shown in a separate volume.

Retaining Wall

The mechanically stabilized earth (MSE) retaining wall system was adopted along approach road, which aims at minimizing land acquisition and facilitate rapid construction.

19.3.2 Preliminary Design of Road

(1) Study of Intersection Improvement

The bridge approach will be connected to Natividad Lopez (Concepcion) and San Marcelino in the south area of Pasig River, and Carlos Palanca Sr. in the north area.

Proposed plan of the intersection improvement of both approaches are shown in **Figure 19.3.2-1** and **Figure 19.3.2-2**.

The approach road will be crossed orthogonally to control the traffic flow. As for the south approach area, additional lane was provided for each direction to accommodate right turning movements, and the median will be removed to minimize land acquisition of commercial area at Laurence Arcade. Proper pavement markings and other traffic control devices shall be installed to efficiently direct traffic flows. In addition, latest innovations of signal system shall be proposed.

Carlos Palanca Sr. shall be improved and raised to about 0.50 meters from the existing pavement to meet the approach road of the Second Ayala Bridge at the south side. The raised road shall be provided with retaining wall at both sides to protect adjacent buildings and existing sidewalk. Drainage shall also be provided as part of the intersection improvement.

(2) Approach to the Linear Park

Pasig River Rehabilitation Commission (PRRC) require that all bridge to be constructed/ retrofitted shall provide access stairs to / from the linear park on both sides of upstream/ downstream.

The access to / from the linear park will utilize as the sidewalk at both sides of the bridge. A 3 meter sidewalk width including bridge railings, railings between traffic and pedestrian is provided for protection of pedestrians crossing the bridge.

The access stair is placed in the property of linear park and was designed to be parallel to the linear park.

Approach stair from road surface to Linear Park is shown in **Figure 19.3.2-3**.

19.3.3 Construction Plan

(1) Construction Method of Superstructure

Cantilever erection method was recommended for the construction of prestressed concrete box girder. Erection sequence is shown in **Figure 19.3.3-1**. The superstructure was planned to be erected half by half in order to maintain navigation clearance during construction. Materials were planned to be conveyed by barges.

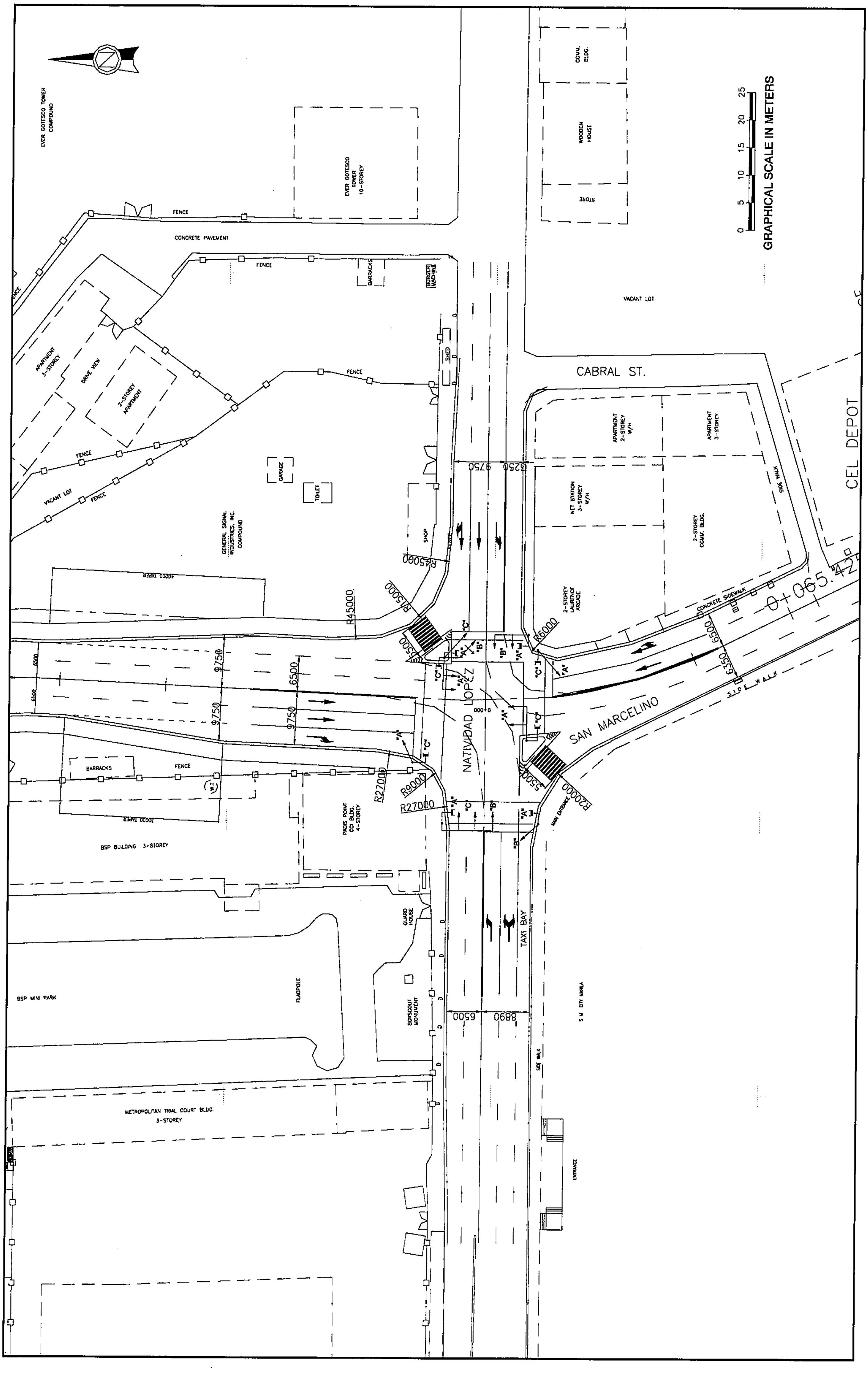


Figure 19.3.2-1 Plan of Intersection along Natividad Lopez (Concepcion)

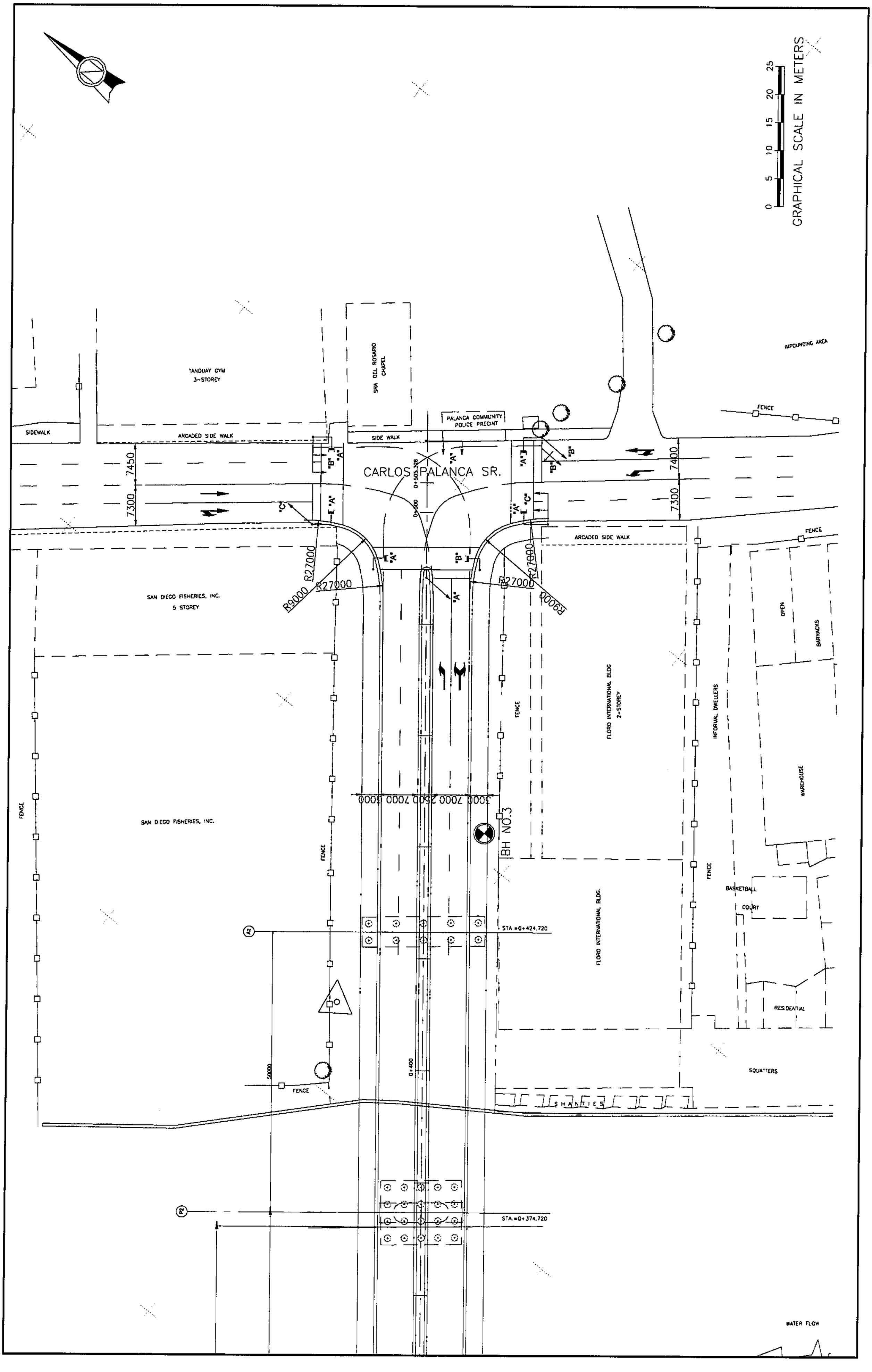


Figure 19.3.2-2 Plan of Intersection along Carlos Palanca Sr.

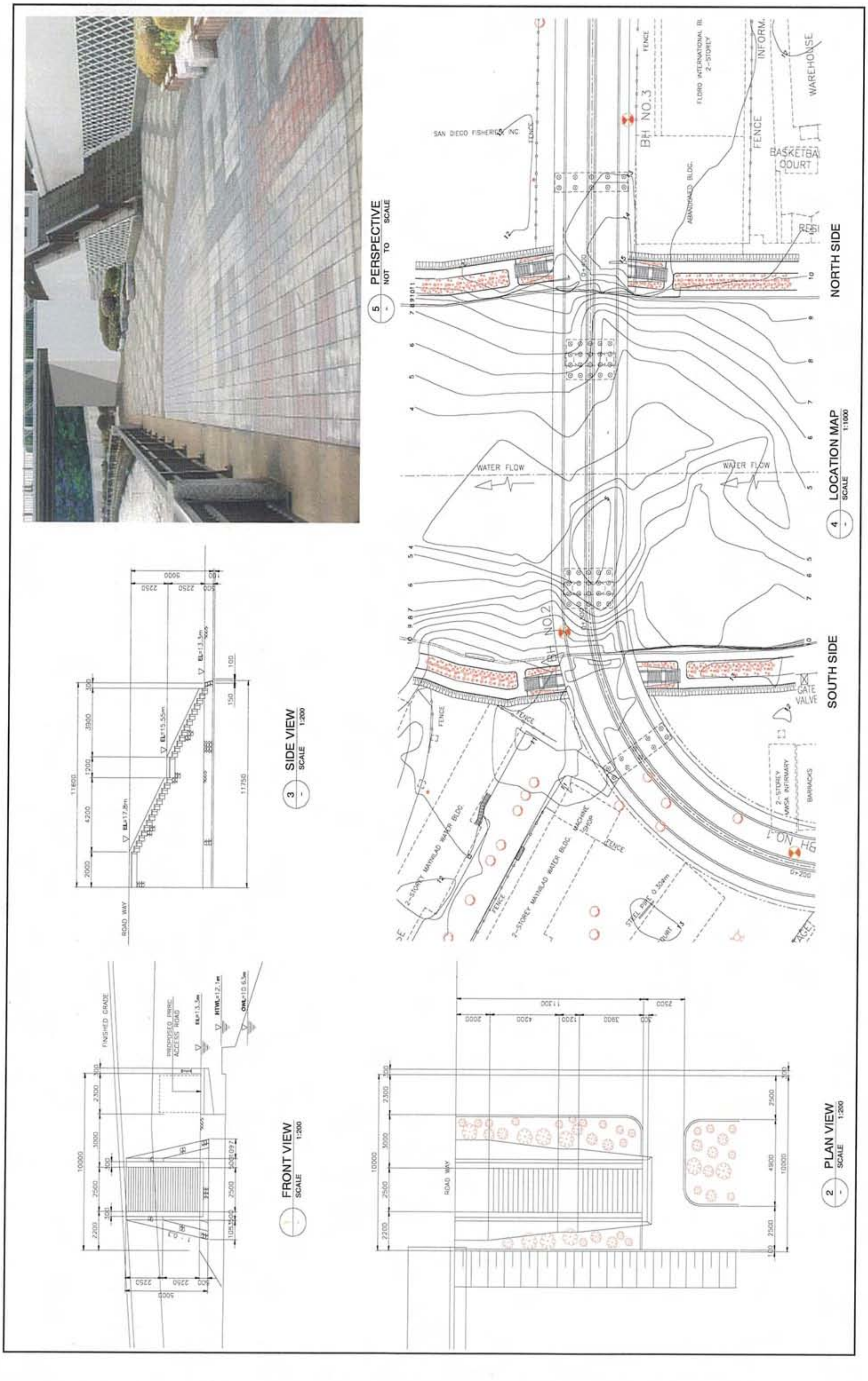


Figure 19.3.2-3 Approach Stair to / from the Linear Park

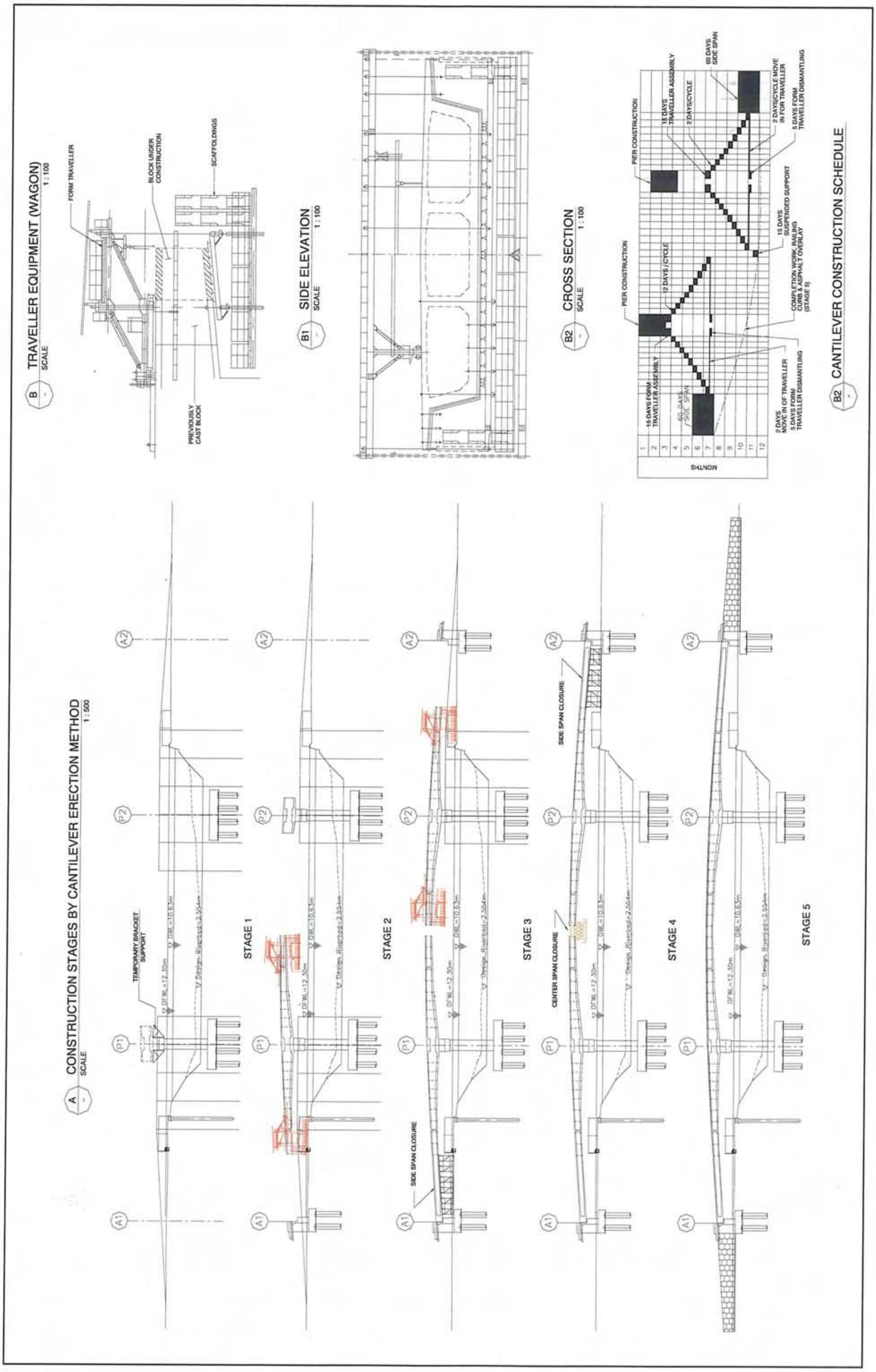


Figure 19.3.3-1 Construction Sequence of Erection

Construction Sequence shall be done as follows:

- Stage 1 – Pier Head and Initial Blocks

  Initial blocks on piers P1 and P2 shall be constructed on temporary bracket support installed at the head of piers.

- Stage 2 – Pier P1 Balanced Cantilever Construction

  After the completion of initial blocks, traveler equipment (wagon) shall be assembled on the established blocks, then the construction of each block shall commence from the existing block to both sides by cantilever method using form traveler simultaneously. Preparation for side span construction work starts.

- Stage 3 – Abutment A1 Side Span Construction and Pier P1 Balanced Cantilever Construction Side Span Construction by Staging (Support/Shoring)

  After the completion of initial blocks, equipment of form traveler shall be assembled on the established blocks, then the construction of each block shall simultaneously commence from the existing block to both sides by cantilevering method. Preparation for side span construction work starts.

- Stage 4 – Center Closure and Abutment A2 Side Span Construction

  Final block at center of pier P1 and pier P2 shall be constructed

  After the completion of initial blocks, equipment of form traveler shall be assembled on the established blocks, then the construction of each block shall simultaneously commence from the existing block to both sides by cantilevering method. Preparation for side span construction work starts.

- Stage 5 – Finishing Works

  All miscellaneous works including surfacing is carried-out.

(2) Construction Method of Substructure

The construction method of substructure is shown in **Figure 19.3.3-2**. The cofferdam is for the construction of bridge piers.

Heavy equipment and materials was planned to be conveyed from approached road.

19.3.4 Preliminary Cost Estimates

(1) Cost Estimation Procedure

The construction cost was estimated based on the results of the preliminary studies, site condition investigation and unit prices of recent bridge or other related structures. Based on the constraints or requirements and results obtained from site investigation, construction sequences and method for each work item are studied and formulated. The construction technology, sequences and method to be employed, approximate number of labor and equipment requirements, and other items are considered.

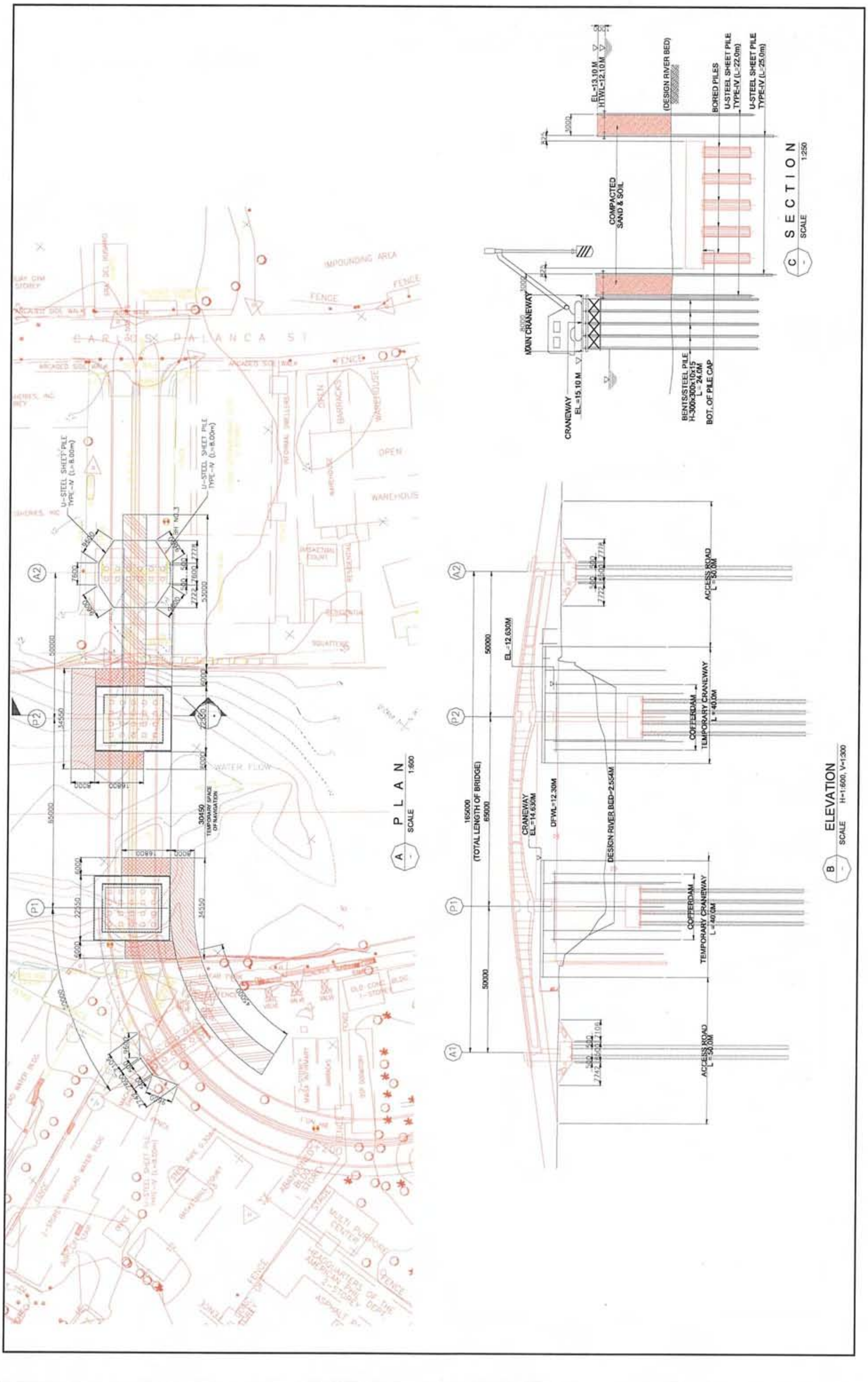


Figure 19.3.3-2 Construction Planning of Substructure

Composition of Construction Cost

The construction cost estimate is composed of the direct cost and indirect cost. The computations are in accordance with the DPWH guidelines.

Three (3) direct cost elements are identified:

- Labor Costs
- Material Costs (Foreign – Imported materials and local materials)
- Equipment Costs

The Indirect Cost considers:

- Overhead
- Profit
- Taxes

Project Cost Components

The Project Cost Components are:

- Total Construction Cost
- A Physical Contingency factor of 5% of the Total Cost
- Engineering Services at 4% of Total Construction Cost
- Construction Supervision at 8% of Total Construction Cost

The breakdown of the Cost is shown in **Appendix 19.3.4-1.**

Right of Way Acquisition Cost

Problems of right of way acquisition and resettlement of affected families are common and often unavoidable to road infrastructure projects in a highly built-up metropolis. The identification and selection of alignment schemes were pursued duly considering the least number of houses/building and families to be affected. **Table 19.3.4-1** presents the project right-of-way impact in the area. Since the selected alignment is located in an area with several vacant spaces, the affected number of buildings is only 9 which are mostly abandoned buildings.

The Right of Way (ROW) for this project is estimated at 11,266 sq.m. Acquisition cost thereof consists of the cost of land and compensation for improvements that will have to be expropriated.

The Estimated Cost for Right of Way is ₱159.69M.

Table 19.3.4-1 Right of Way Acquisition Requirements

Item	Number
No. of Affected Houses	10
No. of Affected Family	3

(2) Project Cost

Project cost is summarized in **Table 19.3.4-2.**

Table 19.3.4-2 Project Cost

In Million Pesos

Items	Cost	
Construction Cost	Foreign	425.750
	Local	132.33
	Tax	89.53
	Sub-Total	647.620
Right of Way Cost	Foreign	-
	Local	171.00
	Tax	19.00
	Sub-Total	190.00
Engineering Cost	Foreign	57.036
	Local	36.294
	Tax	10.370
	Sub-Total	103.700
Project Cost	Total	941.32

19.4 TRAFFIC ANALYSIS AND ECONOMIC EVALUATION

19.4.1 Traffic Survey and Analysis

(1) Intersection Traffic Survey

A survey on traffic movements at eight (8) intersections shown in **Figure 19.4.1-1** was conducted:

- To estimate the possible traffic volume on the proposed second Ayala Bridge,
- To propose traffic regulations in the vicinity areas of the second and existing Ayala Bridges after construction, and
- To use traffic data for economic evaluation.

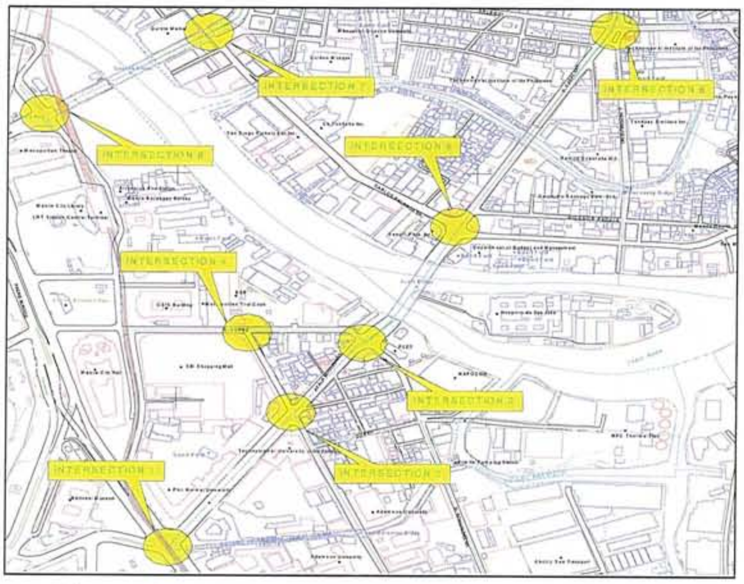


Figure 19.4.1-1 Location Map of Intersection Traffic Survey

The traffic movements at the intersections were counted by the traffic direction and by the vehicle type as follow:

a) car/jeep/taxi/pick up/van, c) bus with 2-axle, e) tricycle
b) passenger jeepneys, d) truck trailers, f) motor cycle

Table 19.4.1-1 shows daily traffic volume counted at eight (8) intersections. The intersection traffic count survey was originally carried out 12-hour and this survey data was expanded to 24-hour traffic volume using the 24-hour expansion factor obtained in the traffic survey data conducted in November 2002 under this study.

Table 19.4.1-1 Daily Traffic Volume at Each Intersection

Veh / Day

	Intersection	Car / Pick-up	Jeepney	Large Bus	Truck / Trailer	Sub-Total	Tricycle	Motor Bike	TOTAL
1	Taft Ave / Ayala Blvd. Int	62,482	14,992	6,088	8,275	91,837	65	4,138	96,041
2	Ayala Blvd / San Marcelino Int.	35,101	334	1,512	7,588	44,535	123	2,421	47,079
3	Ayala Bridge South Int.	45,933	862	1,047	4,290	52,132	156	4,560	56,848
4	Almeda Lopez / San Marcelino St Int.	26,019	877	812	1,326	29,034	155	2,326	31,514
5	Ayala Bridge North Int.	38,156	4,747	790	1,512	46,204	127	3,827	50,158
6	Arlegui Ave / P Casal Int.	26,620	6,230	512	905	34,268	123	3,152	37,543
7	Carlos Palanca / Quezon Blvd Int.	15,008	4,576	386	966	20,936	304	1,524	22,764
8	Quezon Bridge South Int.	40,960	23,794	3,318	1,151	69,222	63	1,768	71,053

Notes: 1) Expansion Factor: Car/Pick-up = 1.46 Jeepney = 1.21 Large Bus = 1.40 Truck/Trailer = 2.30 Tricycle = 1.46 Motor Bike = 1.36

(2) Calibration of OD traffic Volume

(a) Procedure for Traffic Analysis

Figure 19.4.1-2 shows the procedure for traffic analysis of Manila City Area which can be defined as the influence area of the Ayala Bridge and the Second Ayala Bridge. Three (3) major steps were performed for the analysis:

Step 1: Calibration of OD matrix in Manila City Area
Step 2: Future traffic demand on intersections
Step 3: Intersection traffic analysis

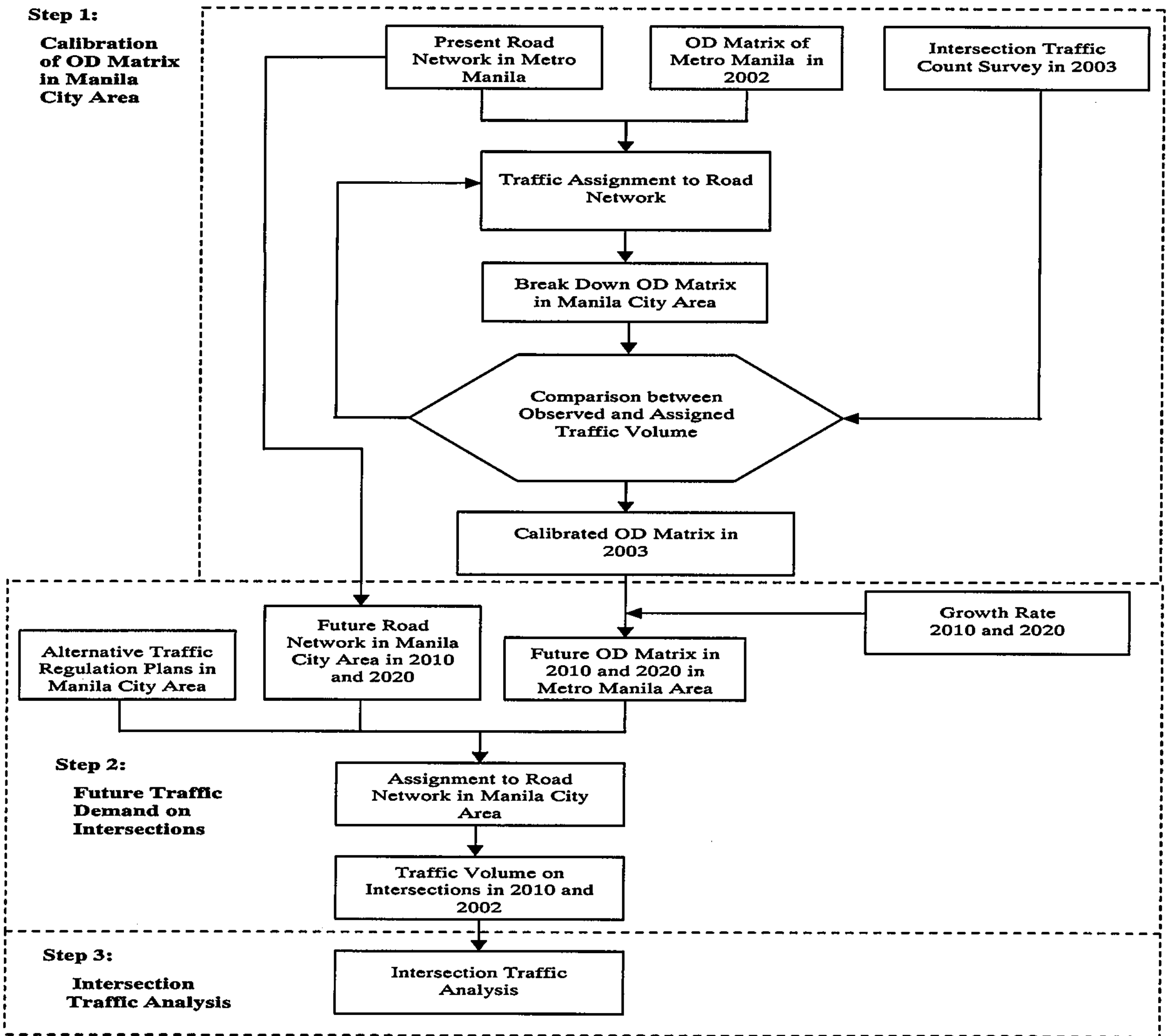


Figure 19.4.1-2 Procedure for Traffic Analysis near Ayala and Second Ayala Bridge

(b) Calibration of OD Matrix in Manila City Area

Following the above procedure the OD matrix in Manila City Area is derived from the OD Matrix of Metro Manila. Then this OD matrix in Manila City Area was calibrated by comparing the observed traffic volume with the assigned traffic volume on road links and intersections. The results of the calibrations are shown in **Figures 19.4.1-3 (1)** and **(2).**

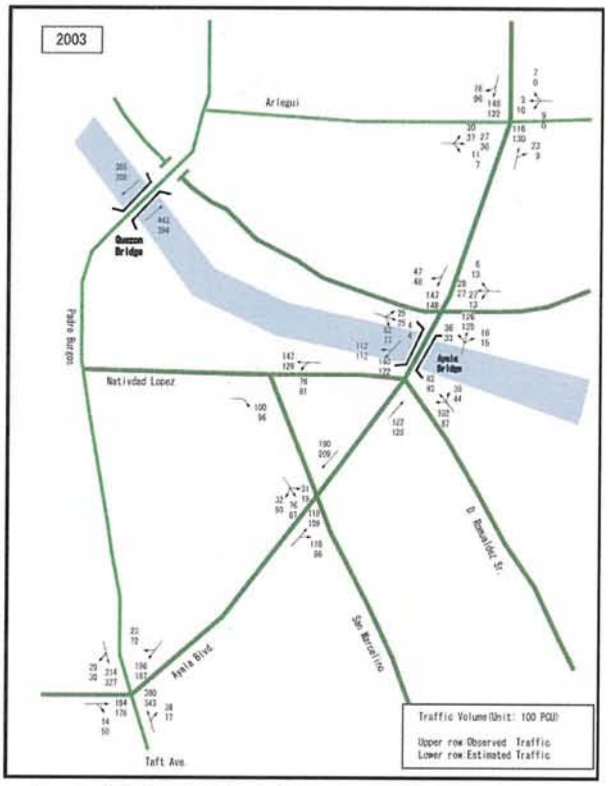


Figure 19.4.1-3 (1) Calibration of Observed and Estimated Traffic Volume at Intersection

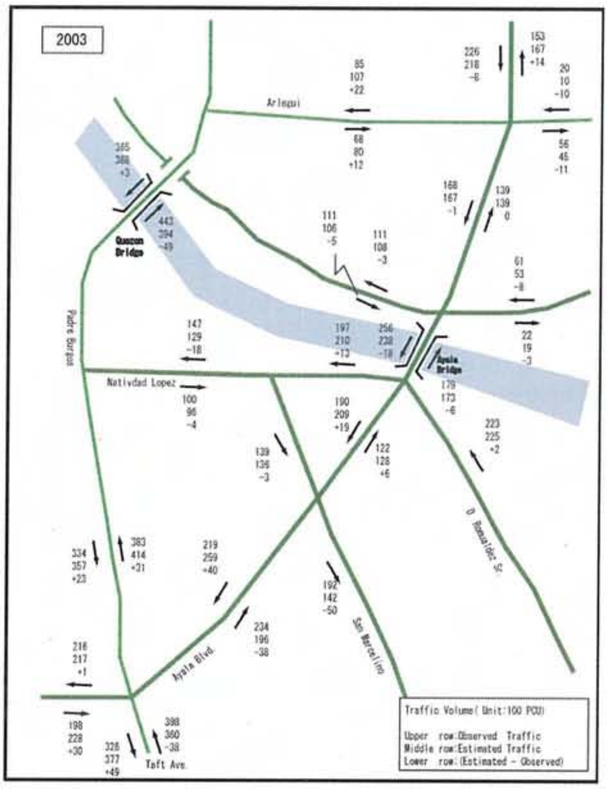


Figure 19.4.1-3 (2) Calibration of Observed and Estimated Traffic Volume on Road Links

According to the two (2) figures above, the calibration of OD matrix was judged to be sufficient because the difference between the calculated traffic volume and the observed one is acceptable.

(c) Future Traffic Demand Projection

The future traffic demand projection was made for the two (2) alternative cases as shown in **Table 19.4.1-2**.

Table 19.4.1-2 Alternative Cases of Bridge Plans and Regulation Plans for Future Traffic Demand

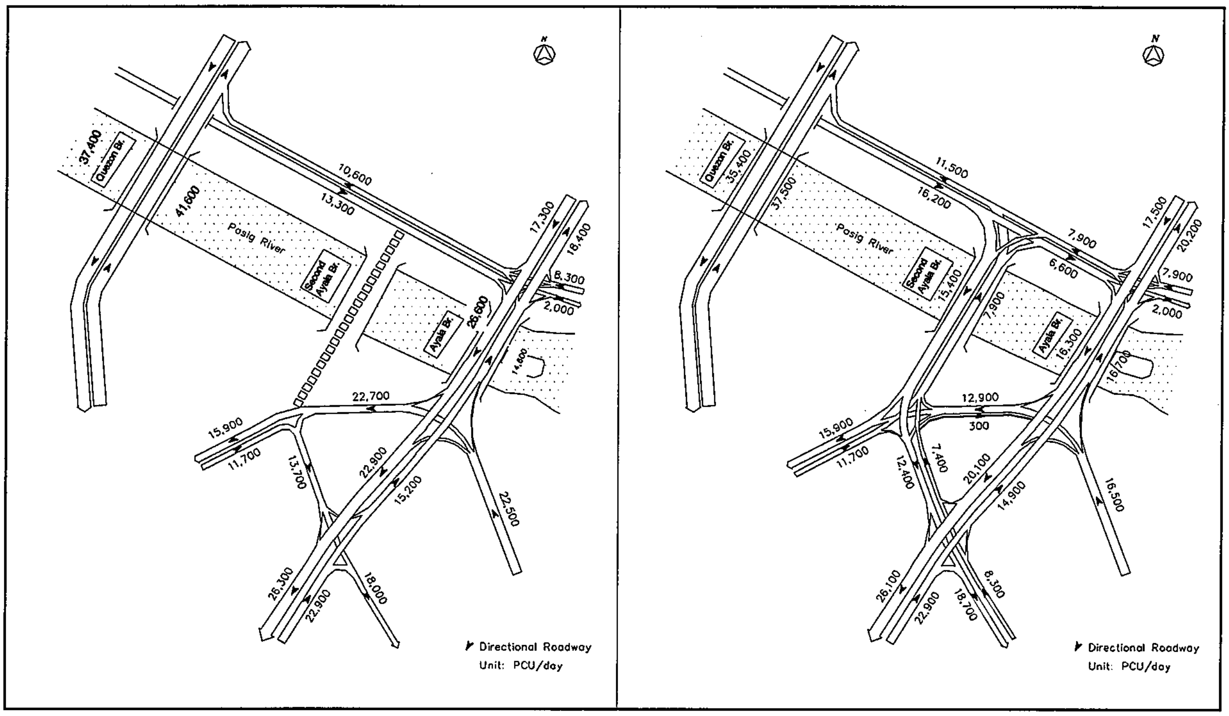
Case	Main Features
Case 1	1. No construction of the Second Ayala Bridge 2. Adoption of present traffic regulation
Case 2	1. Construction of the Second Ayala Bridge 2. Modification of present traffic regulation - Both way of San Marcelino - Both way of Natividad Lopez between Ayala Bridge South Intersection and the Second Ayala Bridge South Intersection

The results of traffic demand forecast on the bridges in 2010 and 2020 are shown in **Table 19.4.1-3** and the traffic flow on road links and intersections is shown in **Figure 19.4.1-4.**

Table 19.4.1-3 Traffic Demand Forecast on Bridges

Year	Comparison Item	CASE1				CASE 2			
		Ayala Bridge	Second Ayala Bridge	Quezon Bridge	Total	Ayala Bridge	Second Ayala Bridge	Quezon Bridge	Total
2003		41,100	-	76,200	117,300	41,100	-	76,200	117,300
2010	Traffic Vol. Compared with Case 1	-	-	-	-	-	-	-	-
2020	Traffic Vol. Compared with Case 1	70,900	-	94,800	165,700	51,000 -19,900	33,900 33,900	86,300 -8,500	171,200 (5,500)

Note: • ( ): Traffic volume from other bridges by second Ayala Bridge construction
• Comparing with Case 1 is intended to estimate Second Ayala Bridge construction effect.



CASE 1: WITHOUT SECOND AYALA BRIDGE (YEAR 2010) CASE 2: WITH SECOND AYALA BRIDGE (YEAR 2010)

Figure 19.4.1-4 Traffic Demand Forecast on Intersections in 2010

Aiming at the traffic volume on the Second Ayala Bridge and its complementary function to the existing Ayala Bridge, Case 2 is a better solution.

(3) Intersection Traffic Analysis

(a) Method for Analysis of LOS

In the traffic analysis for signalized intersections, the Highway Capacity Software (HCS) 2000 was utilized. Using the HCS 2000 software, the signalized intersection analysis is performed based on the following procedure, as shown in **Figure 19.4.1-5.**

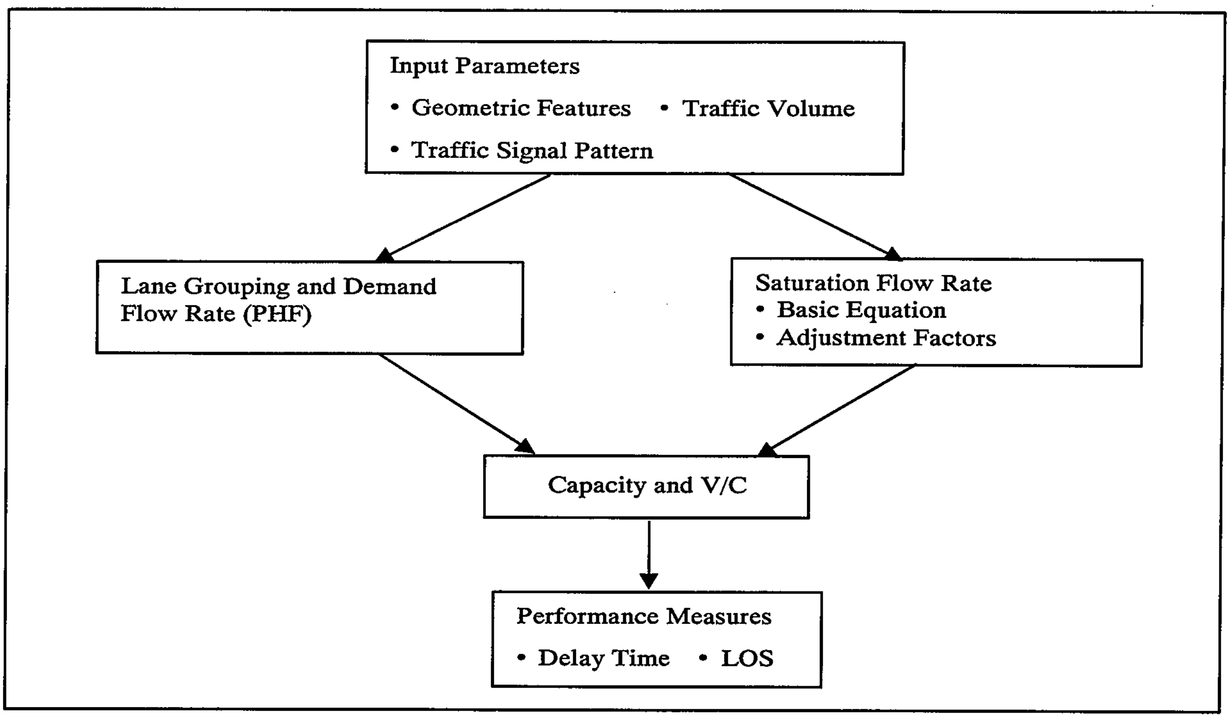


Figure 19.4.1-5 Procedure for Signalized Intersection Analysis

(b) Level of Service (LOS) at Intersections

Following the procedure above, the Level of Service (LOS) at seven (7) signalized intersections were estimated as shown in **Table 19.4.1-4.**

Judging from **Table 19.4.1-4** the LOS at all signalized intersections are considered to be at an acceptable level even if the second Ayala Bridge is constructed. Therefore, the construction of the second Ayala Bridge does not generate any traffic congestion within the influence area, nor does it relieve traffic congestion in the area.

(4) Recommendation

Based on the above examinations, it can be judged that Case2 (construction of second Ayala Bridge and modified traffic regulation) is the most preferable among other alternative cases. Therefore, the following recommendations can be made:

- The second Ayala Bridge shall be constructed from the viewpoint of traffic, and
- The traffic regulation plan around second Ayala Bridge shall be employed under Case 2.

Table 19.4.1-4 Level of Service at Intersections around Second Ayala Bridge

Case	LOS			Intersection Delay (sec/veh)			Xx (=v/c)		
	Present	Case1	Case2	Present	Case1	Case2	Present	Case1	Case2
Year Second Ayala Bridge Traffic Regulation	2003 W/O	2010 W/O	2010 W	2003 W/O	2010 W/O	2010 W two-way*	2003 W/O	2010 W/O	2010 W two-way*
Int. No. 1	D	E	E	39.6	69.1	62.4	0.72	0.94	0.92
Int. No. 2	D	D	D	44.6	43.9	45.1	0.57	0.70	0.81
Int. No. 3	D	D	C	29.9	36.9	28.1	0.74	0.96	0.64
Int. No. 4	-	-	D	-	-	36.0	-	-	0.74
Int. No. 5	D	E	C	42.9	55.8	**33.1**	0.83	0.91	**0.67**
Int. No. 6	C	C	C	22.9	21.4	21.2	0.59	0.47	0.50
Int. No. 7	-	-	D	-	-	44.0	-	0	-

Note: 1) In case of changing the traffic regulation on NATIVIDAD LOPEZ St. (02km) SAN MARCELINO St. (1.0km) (Change from One way to two way)

LOS (Level of Service)

A:	<10 sec/veh	LOS A occur when progression is extremely favorable and most vehicles arrive during the green phase. Many vehicles do not stop at all.
B:	>10-20	LOS B generally occurs with good progression, short lengths, or both. More vehicles still pass through the intersection without stopping.
C:	>20-35	Though higher delays may result from only fair progression, longer cycle length or both, many vehicles still pass through the intersection without stopping.
D:	>35-55	At LOS D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression. Long cycle lengths and high v/c ratios.
E:	>55-80	These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios.
F:	>80	This level considered unacceptable to most drivers, often occurs with over saturation.

19.4.2 Economic Analysis

(1) Procedure for Economic Analysis

The economic evaluation of the Project is principally made in comparison between the benefits and costs which are derived from with and without the second Ayala Bridge Project. Therefore, the evaluation procedure illustrated in **Figure 19.4.2-1** is employed in this study. In order to estimate the benefit, a method of the traffic assignment to road networks with and without the project is used.

By comparing the benefits and costs of the project, the benefit cost analysis will be made.

(2) Presumptions

(a) Type of Benefits

The benefits derived from the Second Ayala Bridge can be defined as those with and without the project in principle. The project being completed can be defined as "with the project". While the project being not implemented can be defined as "without the project". There are various benefits derived from the construction of the Second Ayala Bridge, among the tangible benefits taken into account in this study are:

- Reduction of vehicle operating cost, and
- Reduction of travel time costs

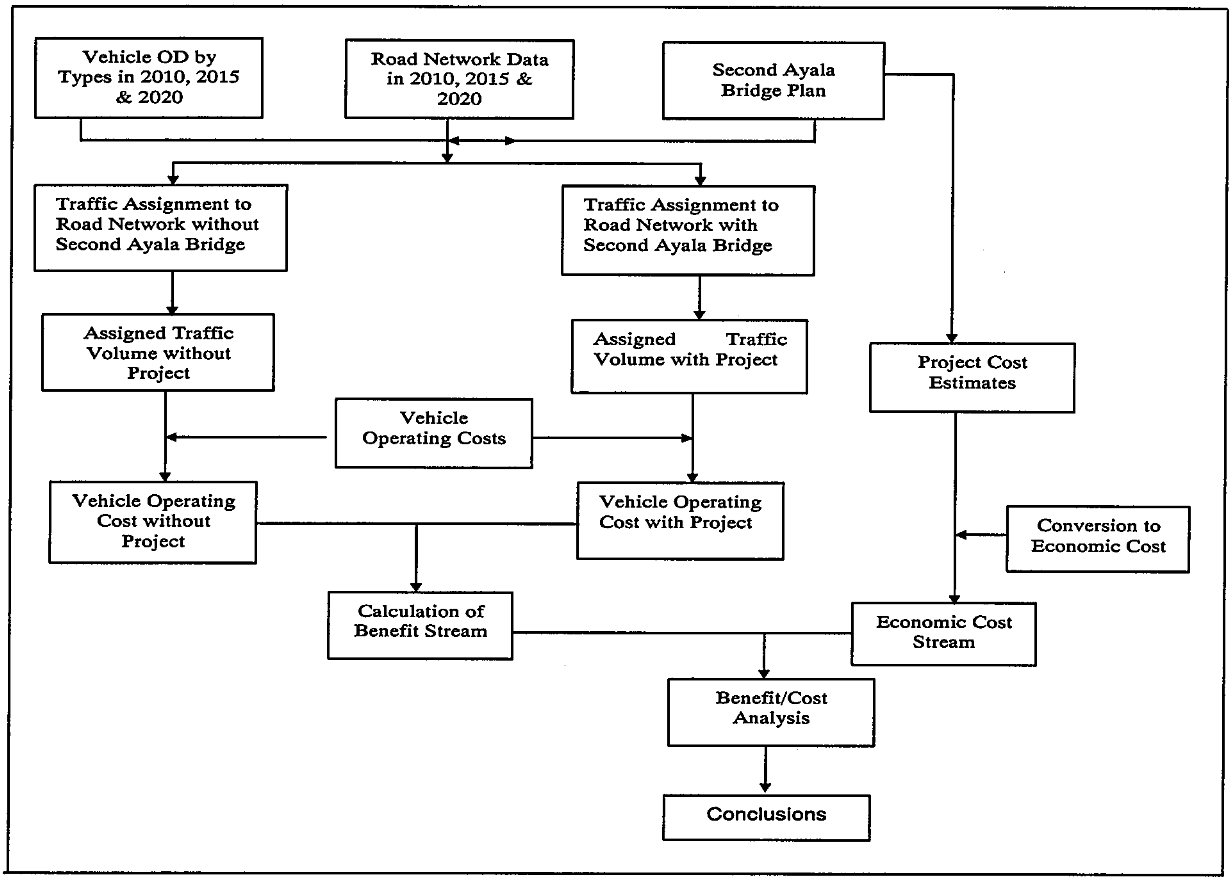


Figure 19.4.2-1 Procedure for Economic Evaluation

(b) Implementation Plan of the Project and Evaluation Period

According to the preliminary implementation schedule, the following schedule is assumed:

- Detailed Design: 2007 to 2008
- Tendering Stage: 2008
- Construction: 2009 to 2010
- Opening to traffic: 2011

The evaluation period is assumed to be 30 years from third quarter to 2014 to second quarter of 2043.

(c) Economic Indicators

The economic indicators principally employed is the benefit cost analysis, which evaluates investment efficiency through comparison between costs and benefits derived from the construction of the Second Ayala Bridge. It is expressed as the benefit cost stream during the evaluation period with the following economic indicators used in this study:

- Net Present Value (NPV)
- Benefit Cost (B/C) Ratio, and
- Economic Internal Rate of Return (EIRR)

(d) Discount Rate

The discount rate is assumed to be 15%.

(3) Economic Cost

(a) Construction Cost

The project cost, which was already calculated in the previous section, is expressed from financial cost to economic cost using conversion factors. The economic cost of the project is shown in **Table 19.4.2-1.**

Table 19.4.2-1 Economic Cost of the Project

Unit: 000 Pesos

		Economic Cost	Financial Cost
1	Construction Cost	557,003	647,620
1.1	Superstructure	249,103	289,620
1.2	Substructure	229,700	267,100
1.3	Highway	78,200	90,900
1.4	Detour	0	0
2	Consultancy Cost		
2.1	Detailed Design	35,058	38,900
2.2	Construction Supervision	52,244	64,800
3	ROW Acquisition	171,000	190,000
	Total	815,305	941,320

(b) Maintenance Cost

The maintenance cost of the bridge varies by bridge types. In case of PC concrete bridge applied to the Second Ayala Bridge, it is generally said that the annual maintenance costs of the said bridge is cheaper than the steel bridge. According to the maintenance study made in this study, the present maintenance costs for the bridges in Metro Manila are estimated for about 1% of the construction cost. In this study, therefore, the maintenance cost is assumed to be 1% of the construction cost.

(c) Estimation of Benefits

Basic Vehicle Operating Cost

The Vehicle Operating Cost (VOC) used in this section is the same as the VOC shown in Section 16.2.3.

Traffic Demand on the Second Ayala Bridge

In order to estimate the benefits, the traffic demand forecast in cases of "with" and "without" the Second Ayala Bridge Project is used and shown in **Table 19.4.2-2** and **19.4.2-3.**

Table 19.4.2-2 Vehicle Kilometers With and Without the Project

Year	W/O Project	W/ Project	W/O – W/
2010	2,708,317	2,681,563	26,754
2020	3,507,732	3,436,236	71,496

Table 19.4.2-3 Vehicle Hours With and Without the Project

Year	W/O Project	W/ Project	W/O – W/
2010	147,580	145,444	2,136
2010	246,089	223,361	221,728

(3) Benefit Calculation

The savings in vehicle operating costs and in travel time is quantified by means of the same formula in **Section 16.2.3.**

Saving in vehicle operating costs and travel time cost are estimated and are shown in **Table 19.4.2-4.**

Table 19.4.2-4 Estimation of Benefits

000 Pesos

Year	Savings in VOC	Savings in Fixed Cost	Savings in Time Cost	Total Savings
2010	43,232.0	18,818.5	49,800.8	111,851.3
2020	115,531.0	200,216.7	529,849.0	845,596.7

(4) Economic Analysis

Based on the above-mentioned benefit and cost estimations the economic analysis of the Second Ayala Bridge project is made and the results of the analysis are shown in **Table 19.4.2-5** while **Table 19.4.2-6** shows the benefit cost stream. **Table 19.4.2-5** shows a net present value of ₱ 965 million and BC ratio of 2.19 over 30 years life of the project using discount rate of 15%. The economic internal rate of return (EIRR) is calculated at **22.3%.**

Table 19.4.2-5 Results of Benefit – Cost Analysis

Net Present Value	965,226
BC Ratio	2.192
EIRR	22.30%

From this table, it can be judged that implementation of the Ayala Bridge can be justified from the national economic point of view, since the economic indicator of the project is over the cut-off level designated as 15% by NEDA.

Table 19.4.2-6 Benefit – Cost Stream of Second Ayala Bridge Construction Project

Undiscounted BenefiT Cost Stream

000 Pesos

Sq	Year	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	0.0	0.0	0.0	0.0	0.0
2	2005	0.0		0.0	0.0	0.0
3	2006	0.0		0.0	0.0	0.0
4	2007	114,600.0		114,600.0	0.0	-114600.0
5	2008	387,250.0	0.0	387,250.0	0.0	-387250.0
6	2009	301,750.0	0.0	301,750.0	0.0	-301750.0
7	2010	803,600.0	0.0	803,600.0	0.0	-803600.0
8	2011	0.0	5,569.0	5,569.0	134,624.8	129,055.8
9	2012	0.0	5,569.0	5,569.0	162,744.1	157,175.1
10	2013	0.0	5,569.0	5,569.0	197,560.1	191,991.1
11	2014	0.0	5,569.0	5,569.0	240,776.1	235,207.1
12	2015	0.0	5,569.0	5,569.0	294,541.5	288,972.5
13	2016	0.0	5,569.0	5,569.0	361,569.6	356,000.6
14	2017	0.0	5,569.0	5,569.0	445,287.1	439,718.1
15	2018	0.0	5,569.0	5,569.0	550,023.4	544,454.4
16	2019	0.0	5,569.0	5,569.0	681,250.3	675,681.3
17	2020	0.0	5,569.0	5,569.0	845,596.7	840,027.7
18	2021	0.0	5,569.0	5,569.0	948,954.6	943,385.6
19	2022	0.0	5,569.0	5,569.0	1,065,612.7	1,060,043.7
20	2023	0.0	5,569.0	5,569.0	1,197,320.0	1,191,751.0
21	2024	0.0	5,569.0	5,569.0	1,346,057.4	1,340,488.4
22	2025	0.0	5,569.0	5,569.0	1,514,069.1	1,508,500.1
23	2026	0.0	5,569.0	5,569.0	1,703,896.9	1,698,327.9
24	2027	0.0	5,569.0	5,569.0	1,918,420.2	1,912,851.2
25	2028	0.0	5,569.0	5,569.0	2,160,901.0	2,155,332.0
26	2029	0.0	5,569.0	5,569.0	2,435,034.7	2,429,465.7
27	2030	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
28	2031	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
29	2032	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
30	2033	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
31	2034	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
32	2035	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
33	2036	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
34	2037	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
35	2038	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
36	2039	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1
37	2040	0.0	5,569.0	5,569.0	2,745,008.1	2,739,439.1

Discounted BenefiT Cost Stream

000 Pesos

Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	1.000	0.0	0.0	0.0	0.0	0.0
2	2005	1.150	0.0	0.0	0.0	0.0	0.0
3	2006	1.323	0.0	0.0	0.0	0.0	0.0
4	2007	1.521	75,351.4	0.0	75,351.4	0.0	-75351.4
5	2008	1.749	221,411.4	0.0	221,411.4	0.0	-221411.4
6	2009	2.011	150,023.1	0.0	150,023.1	0.0	-150023.1
7	2010	2.313	347,418.5	0.0	347,418.5	0.0	-347418.5
8	2011	2.660	0.0	2,093.6	2,093.6	50,610.5	48,516.9
9	2012	3.059	0.0	1,820.5	1,820.5	53,201.3	51,380.8
10	2013	3.518	0.0	1,583.1	1,583.1	56,158.9	54,575.8
11	2014	4.046	0.0	1,376.6	1,376.6	59,516.2	58,139.6
12	2015	4.652	0.0	1,197.0	1,197.0	63,309.7	62,112.7
13	2016	5.350	0.0	1,040.9	1,040.9	67,579.9	66,539.0
14	2017	6.153	0.0	905.1	905.1	72,371.6	71,466.5
15	2018	7.076	0.0	787.1	787.1	77,734.1	76,947.0
16	2019	8.137	0.0	684.4	684.4	83,721.9	83,037.5
17	2020	9.358	0.0	595.1	595.1	90,364.5	89,769.4
18	2021	10.761	0.0	517.5	517.5	88,182.5	87,665.0
19	2022	12.375	0.0	450.0	450.0	86,107.0	85,657.0
20	2023	14.232	0.0	391.3	391.3	84,130.1	83,738.8
21	2024	16.367	0.0	340.3	340.3	82,244.5	81,904.2
22	2025	18.822	0.0	295.9	295.9	80,443.5	80,147.6
23	2026	21.645	0.0	257.3	257.3	78,721.0	78,463.7
24	2027	24.891	0.0	223.7	223.7	77,071.4	76,847.7
25	2028	28.625	0.0	194.5	194.5	75,489.5	75,295.0
26	2029	32.919	0.0	169.2	169.2	73,970.6	73,801.4
27	2030	37.857	0.0	147.1	147.1	72,510.3	72,363.2
28	2031	43.535	0.0	127.9	127.9	63,052.4	62,924.5
29	2032	50.066	0.0	111.2	111.2	54,828.2	54,717.0
30	2033	57.575	0.0	96.7	96.7	47,676.7	47,580.0
31	2034	66.212	0.0	84.1	84.1	41,458.0	41,373.9
32	2035	76.144	0.0	73.1	73.1	36,050.4	35,977.3
33	2036	87.565	0.0	63.6	63.6	31,348.2	31,284.6
34	2037	100.700	0.0	55.3	55.3	27,259.3	27,204.0
35	2038	115.805	0.0	48.1	48.1	23,703.7	23,655.6
36	2039	133.176	0.0	41.8	41.8	20,612.0	20,570.2
37	2040	153.152	0.0	36.4	36.4	17,923.4	17,887.0
		Total	794,204.4	15,682.1	809,886.5	1,775,112.2	965,225.7

Net Present Value	965,226
B/C Ratio	2.192
EIRR	22.32

(5) Optimum Timing to Construct Second Ayala Bridge

(a) Approach

In order to find out the optimum timing to construct the Second Ayala Bridge, the first year Benefit Cost Ratio (FYBCR) method is used in this Study. The FYBCR can be presented in the following formula:

$$FYBCR = \frac{Bt}{PC \bullet CRF(i, N)}$$

Where:

Bt:	Benefit in year t
PC:	Project cost
CRF (i,N):	Capital recovery factor
I:	Discount rate
N:	Project life

$$CRF(i,N) = \frac{(1+i)^N \bullet i}{(1+i)^N - 1}$$

If the FYBCR is equal to or larger than 1.0, then the Project construction shall be started but and if it is less than 1.0, then the start of construction shall be deferred until FYBCR reaches 1.0.

(b) Result of the FYBCR Analysis

Figure 19.4.2-2 shows the result of the FYBCR Analysis.

This figure shows that the year which indicates a ratio larger than 1.0 is 2010. Therefore, the optimum timing of construction of Second Ayala Bridge is 2010 as employed in this study.

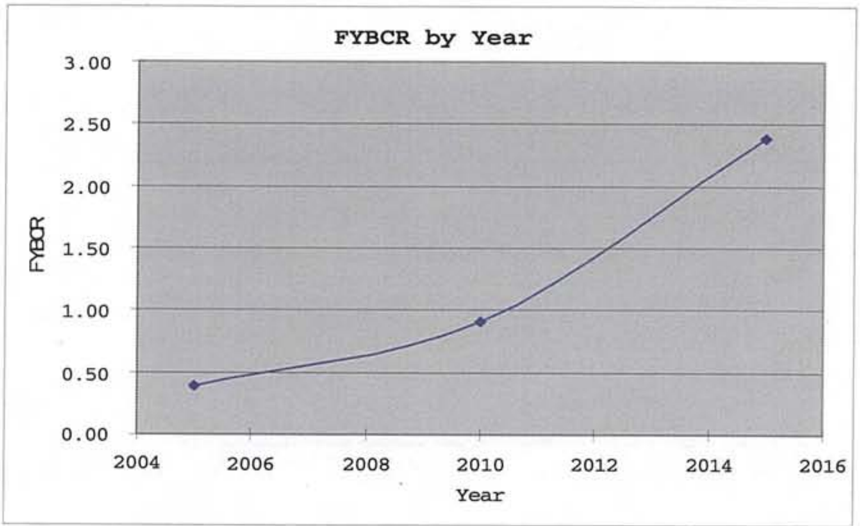


Figure 19.4.2-2 First Year Benefit Cost Ratio (FYBCR) of Second Ayala Bridge