22.3 PRELIMINARY DESIGN AND COST ESTIMATE

22.3.1 Rehabilitation Design

(1) Bridge Design

(a) Scope of Works for Rehabilitation

This preliminary design recommends scheme, "**Slanted Prestressing Cable, Carbon Fiber and Reinforcing Bar Strengthening with Uplift Countermeasure** (Medium Scale Rehabilitation") mentioned in **Section 22.2** Comparative Study. The major improvement measures in this scheme are as follows:

- Rehabilitation of gerber hinge portion with slanted prestressing cables.
- Reconstruction of diaphragm and slab at gerber hinge parts.
- Installation of CFRP (Carbon Fiber Reinforced Polymer) longitudinally on girder above pier support.
- Additional reinforcing bars at top of girder above pier support.
- Additional concrete block doweled to abutment and girder as uplift countermeasure.
- Repair/seal cracks, honeycombs and spallings of concrete.

Figure 22.3.1-1 shows the general view of the rehabilitation works.

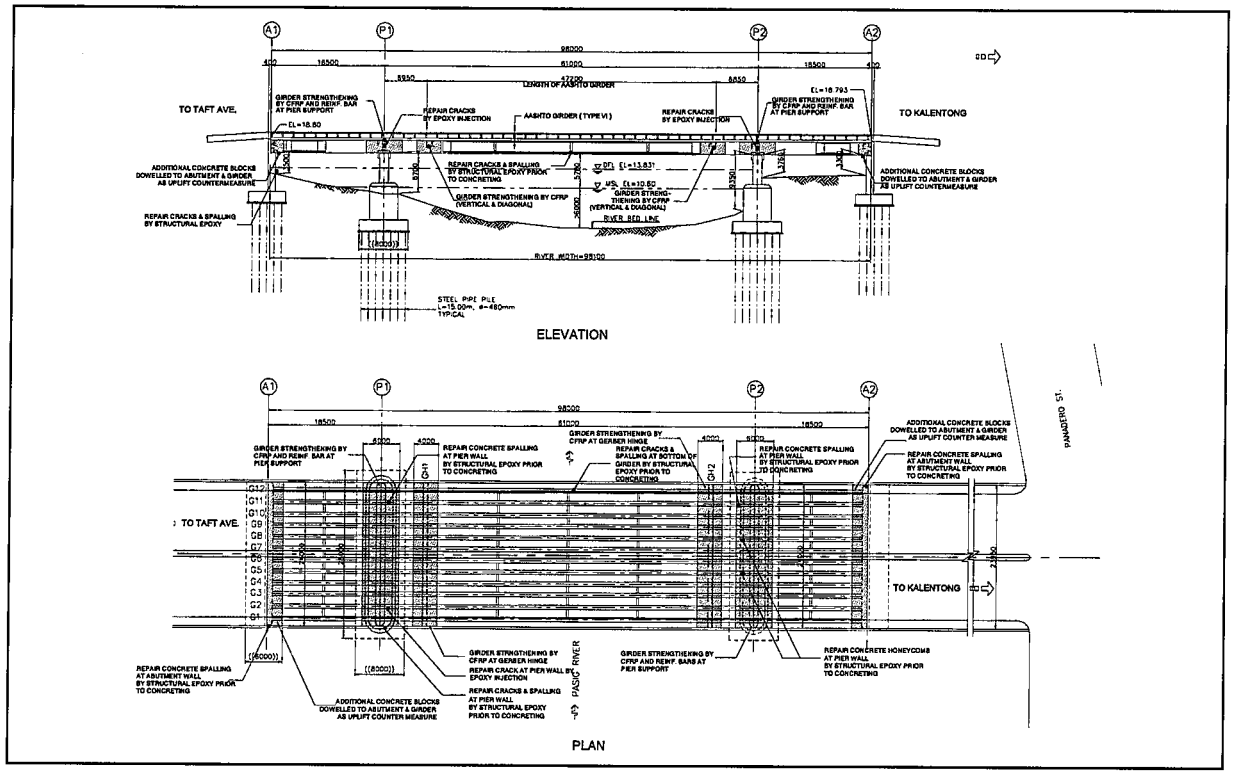


Figure 22.3.1-1 General View of Rehabilitation Works

(b) Design Criteria for Structure

Criteria for materials and loads are shown in **Table 22.3.1-1.**

Table 22.3.1-1 Design Criteria

I. SPECIFICATION	- AASHTO Standard Specification for Highway Bridges, 16 Edition 2000 including Division IA, Seismic Design - Specification for Highway Bridges, Japan Road Association, 1994
II. MATERIALS	- Prestressed Concrete, fc' = 39MPa - Reinforced Concrete, (New) fc' = 28 MPa - Reinforcing Steel (New), Fy = 415MPa - Prestressing cables : (Type F70TS = JIS G 3536 - Area of Strand = 383.80mm fpu = 1860 MPa - Carbon Fiber Reinforce Polymer (CFRP) Tensile – B – Modulus = 300,000 N/mm^2
III. LOADS	- Deadloads Reinforced Concrete = 24.5 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 = Span in meters - Sidewalk Loads For Span more than 20m Sidewalk Loading shall be 2.50 KPa - Earthpressure Mononobe – Okabe Method

(c) Design of Superstructure

The design is to rehabilitate the damaged sections of gerber hinges, top of girder at piers, and uplift anchors at abutments in accordance with the inspections carried out. The detail of the rehabilitation is shown in **Appendix 22.3.1-1 (1/2 to 2/2)**. The major rehabilitation works are as follows:

Gerber hinge Strengthening

The slanted prestressing cables will be installed outside of girders as shown **Figure 22.3.1-2**. The diaphragms at Gerber hinge will be reconstructed with wider ones in order to distribute reactions from deck slab.

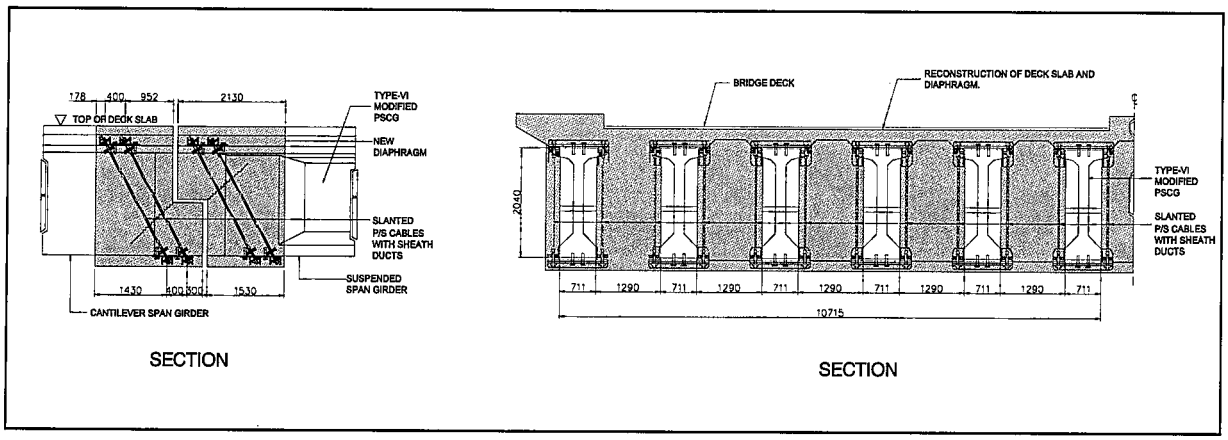


Figure 22.3.1-2 Slanted Prestress Cables Layout

Girder Top Strengthening at Pier

The CRFP (Carbon Fiber Reinforced Polymer) and additional reinforcing bars will be installed outside of girders over piers as shown **Figure 22.3.1-3** in order to increase capacity of longitudinal negative moment.

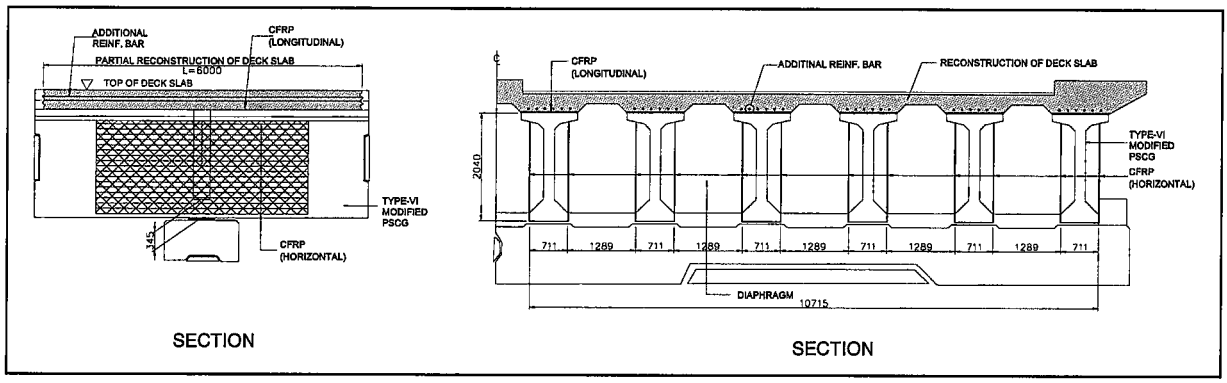


Figure 22.3.1-3 Installation of Carbon Fiber Reinforced Polymer

Uplift Countermeasures at Abutment

Additional reinforcing bars with additional concrete block will be installed at abutment supports as shown **Figure 22.3.1-4** in order to increase capacity of uplift.

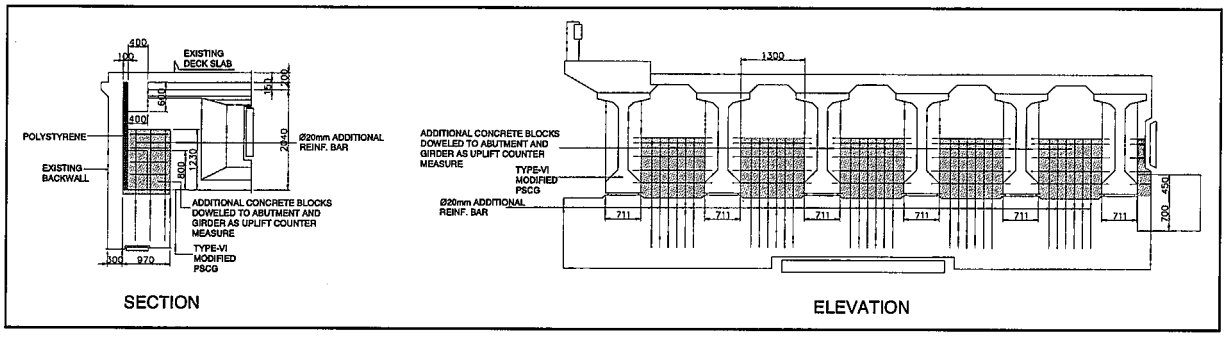


Figure 22.3.1-4 Additional Reinforcing Bars and Concrete Block at Abutment

Result of Structural Analysis

Result of structural analysis are shown in **Table 22.3.1-2.**

Table 22.3.1-2 Result of Structural Analysis

SLANT SHEAR CABLE		
DEMAND	CAPACITY	
	EXISTING	REHABILITATION
985.77 kN	564 Kn * NO AVAILABLE DATA	1409 kN
REMARKS	16 mm#Ø bar spacing : 150 mm c to c	28.5 mm#Ø cable qty : 8 pcs / girder @ gerber hinge
ANCHOR BAR FOR UPLIFT COUNTRMEASURE		
UPLIFT FORCE	CAPACITY OF ANCHOR BAR	
98.78 kN / girder	202.7 kN qty : 6 -20 mmØ rebars / girder	
CARBON FIBER REINFORCED POLYMER (CFRP)		
Specification of CRFP is selected for normal rehabilitation		

Design analysis of rehabilitated portion is presented in **Appendix 22.3.1-2.**

Major Quantity

Major quantity for this rehabilitation work is shown in **Table 22.3.1-3**.

Table 22.3.1-3 Major Quantity for Rehabilitation

Description		Unit	Quantity
A. Repair/Sealing of Concrete Cracks			
SPL	Epoxy Bonding	l.s.	1.00
SPL	Concrete Grouting	c.u.m.	1.00
B. Partial Reconstruction of Deck Slab/New Diaphragm			
101 (3)	Removal of Concrete Slab	sq.m.	439.00
	Removal of Diaphragm	cu.m.	53.07
101 (3)b	Removal of Asphalt	sq.m.	2,264.00
301 (1)	Tack Coat	ton	1.00
310	Asphalt	ton	95.00
405 (1)a	Structural Concrete for Slab	cu.m.	89.00
405 (3)	Structural Concrete for New Diaphragm	cu.m.	233.00
404	Reinforcing Steel Bars	kgs	53,930.00
416 (1)	Prestressing Bar with Anchor	kgs	4,916.00
	Anchorage	each	384.00
C. Installation of Carbon Fiber Reinforced Polymer			
	Installation of CFRP – Wrap	sq.m.	1,986.00
	Installation of CFRP – Strip	l.m.	565.00
D. Steel Railings			
	Reconditioning Steel Railings	l.m.	188.00
	Steel Railings	l.m.	8.00
E. Drainage			
	Reconditioning of Clogged Drainage with Cover	each	1.00

(2) Highway Design

(a) Scope of Works

The highway works include the following items:

- Approach roads of the bridge
- Improvement of two (2) intersections

(b) Design Criteria for Highway

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, 1996 (AASHT0)
- Highway Capacity Manual, Special Report, Transportation Research Boar, 1999
- Road Structure Ordinance, Japan Road Association, 1983 (JRA)

(c) Intersections

The approach intersection (Approach 1) is a minor road intersection. The main road approaching to F.G. Calderon is a narrow road affecting the efficient lane continuity coming from the bridge. Road right-of-way is limited in this section. Thus, it is difficult to be improved.

The excessively wide area in the approach intersection (Approach 2) of F. Manalo St. / Castaneda St. poses traffic and pedestrian safety problems. The frequent jeepney stops just before and after the bridge disrupt the traffic flow.

The basic concept of an intersection design should be to keep its area minimum to the extent as possible. Single Unit (SU) type vehicle was used to design minimum turning movements.

Table 22.3.1-4 shows the existing condition of approaches/ intersections of Lambingan Bridge.

Table 22.3.1-4 Existing Conditions of Approaches /Intersections of Lambingan Bridge

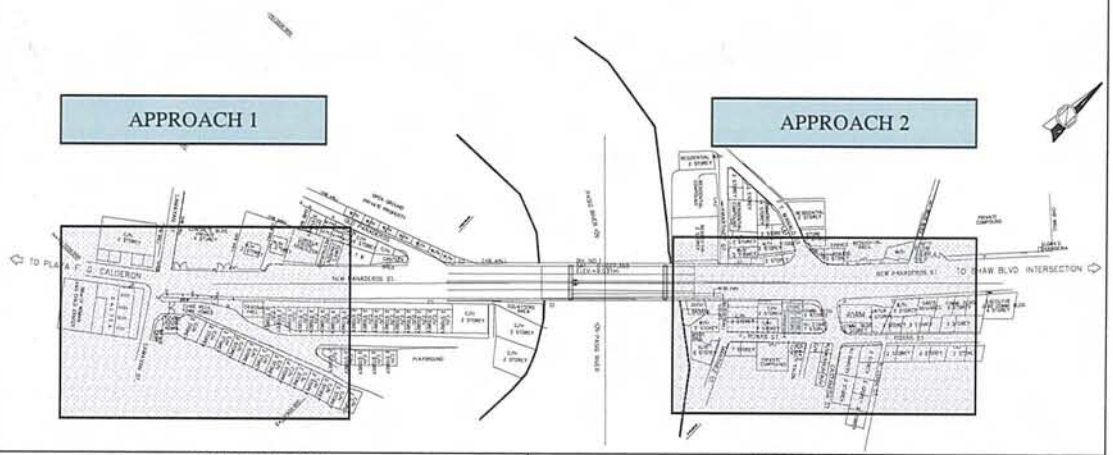
PLAN		
	APPROACH 1	**APPROACH 2**
TRAFFIC	• Traffic coming to/from the bridge are moderate to heavy. Bridge uses three (3) lanes in each direction and tapers to two (2) lanes in each direction near intersection. • **Jeepney terminals are being used just after the bridge coming from Shaw Blvd. This poses danger to through traffic.**	• Jeepney terminals are observed just before the bridge at both sides of the road. This poses danger to through traffic. • **Left turn is observed in all leg of the intersection and it creates a lot of traffic conflicts since it is not signalized.**
PEDESTRIAN	• **Uncontrolled pedestrian crossing.** • No pedestrian crossing is in place.	• **Uncontrolled pedestrian crossing.** • Pedestrian traffic is heavy. • No pedestrian crossing is in place.
GEOMETRIC AND PAVEMENT	• **Lane reduction coming from the bridge poses a risk for through travel.** • Pavement is quite in good condition.	• **Wide intersection road considering a very busy commercial district and roadside parking and terminal.** • Pavement is in good condition.
TRAFFIC SIGNAL, MARKINGS AND SIGNS	• Unsignalized intersection. • Pavement markings are worn out. • **Insufficient traffic signs.**	• Unsignalized intersection. • Pavement markings are not in place. • **Insufficient traffic signs.**
RECOMMEN-DATION	• No improvement is necessary; pavement markings should be laid to guide the traffic for the lane reduction.	• Minor improvement is necessary to provide smaller opening of intersection. • To provide signalization for all traffic direction.

Figure 22.3.1-5 to **Figure 22.3.1-6** illustrate before and after improvement of the Lambingan Bridge approach intersections.

Table 22.3.1-4 Existing Conditions of Approaches/Intersections of Lambingan Bridge

The existing New Panaderos St. has a wide intersection area just after the bridge. Several jeepneys use the lanes as terminals. Pedestrian crosses anywhere in the road although a median fence barrier is in place.

The proposed improvement of the intersection will be to provide a divisional/ median island at approaching intersection, this will regulate the traffic movements of traffic especially vehicles making left turning movements.

Jeepney stop should be controlled and placed farther from the intersection.

Traffic signal should also be placed to avoid congestions if not properly managed by traffic enforcers.

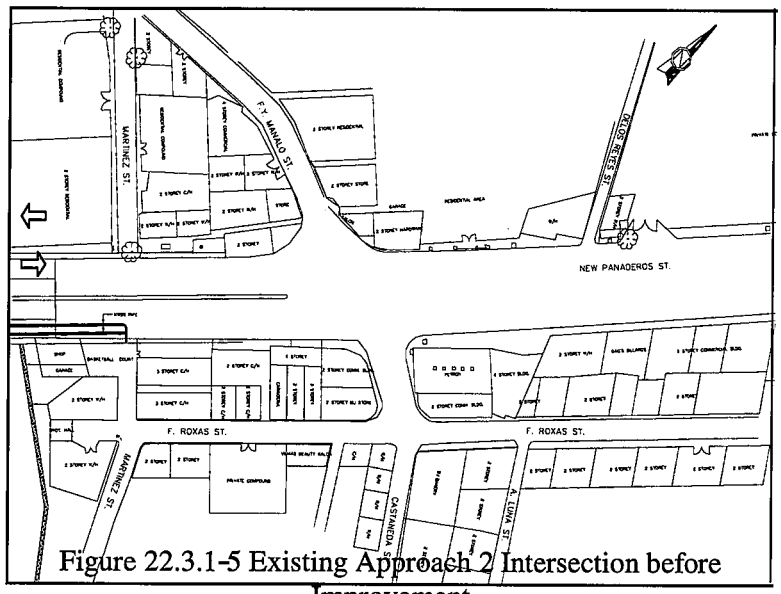


Figure 22.3.1-5 Existing Approach 2 Intersection before Improvement

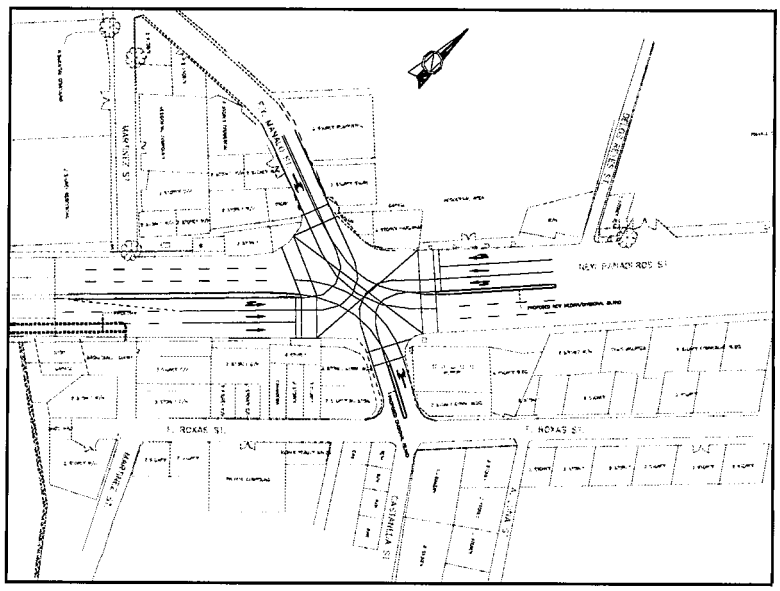


Figure 22.3.1-6 Approach 2 Intersection after Improvement

Improvement of the approach road will include overlaying of the existing pavement at intersection area.

Pavement markings, traffic signs shall be installed.

(d) Approach Road and Access Road

The existing alignment dictates the alignment of improvement design; the horizontal and vertical alignment of the center line of the bridge is maintained.

Access Roads or driveways of nearby buildings should be discouraged to place entrances along the major road since this will obstruct efficient traffic flow especially along approach ramps of the bridge.

The existing site ocular inspections of both approaches are shown in **Appendix 22.3.1-3 (1/2 to 2/2)**

(3) Design of Protection to Vessel Collision

(a) Safety Measure for Superstructure

There are two kinds of vessel collision: collision with superstructure and collision with substructure.

For collision with superstructure, study recommends to adopt the vessel collision avoidance system. **Figure 22.3.1-7** shows the layout of the system.

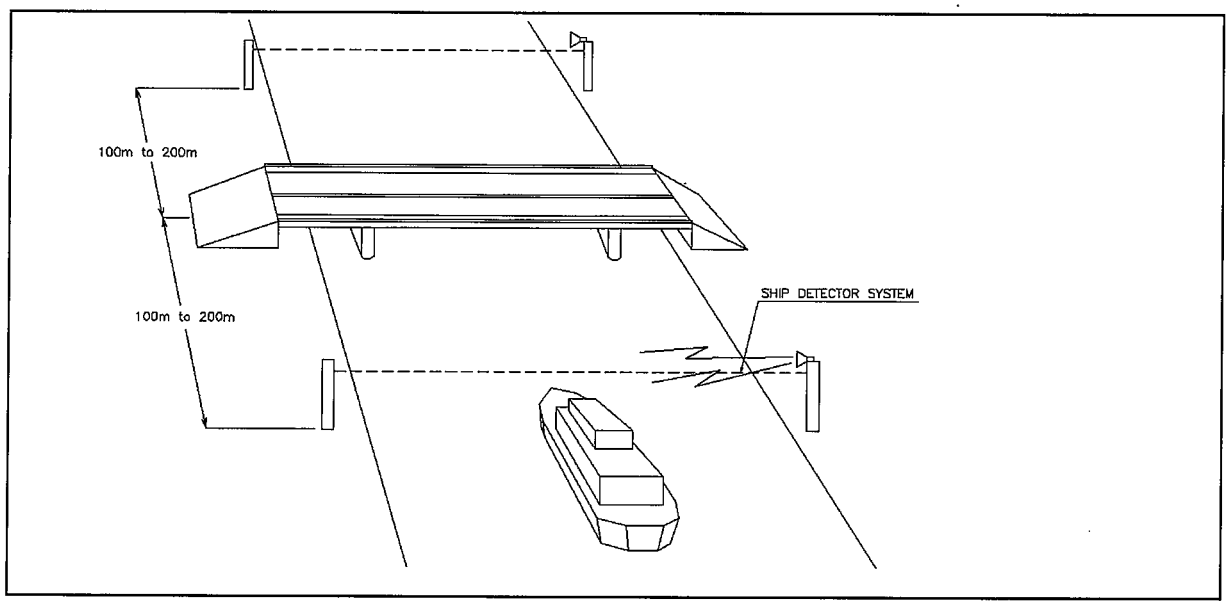


Figure 22.3.1-7 Layout of Vessel Collision Avoidance System

(b) Safety Measure for Substructure

The recommended protection shall be to install fenders on the piers as shown in **Figure 22.3.1-8.**

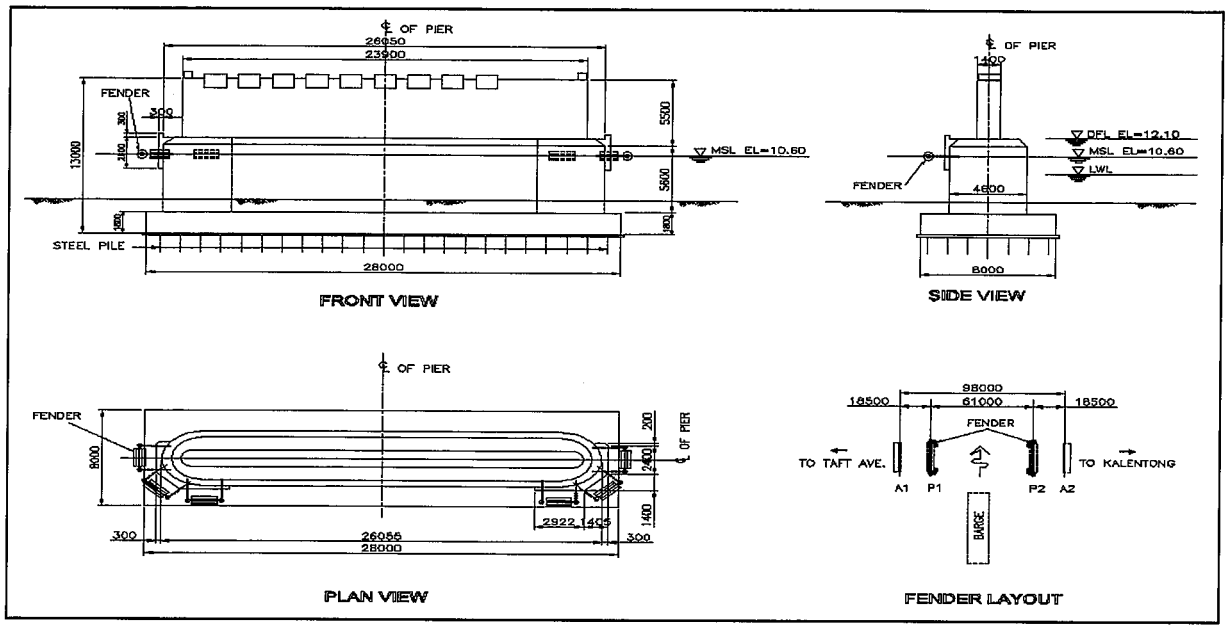


Figure 22.3.1-8 Layout of Vessel Collision Fenders

22.3.2 Construction Plan and Traffic Management

(1) Construction Method

The rehabilitation work shall be carried-out as stage or phase construction of the superstructure. All of the works will be done partially using the installed scaffolding. The construction materials/equipments will be transferred by boom crane from the bridge deck surface to the scaffolding as shown in **Figure 22.3.2-1**. The details of construction method is shown in **Appendix 22.3.2-1**.

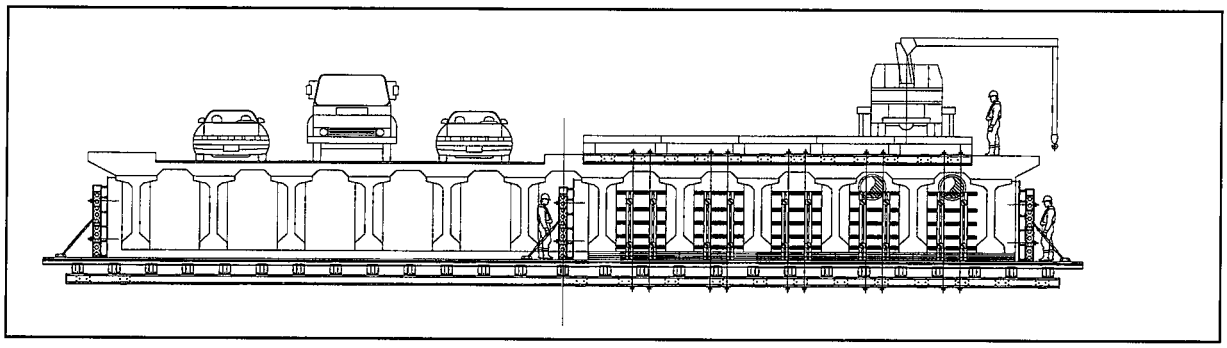


Figure 22.3.2-1 Construction Method

(2) Traffic Management

The construction will be carried out from upstream side to the downstream side as shown in **Figure 22.3.2-1**

The traffic lanes and coarse of the routes will be controlled as shown in **Figure 22.3.2-2** during construction work. In this construction method, the traffic constraints will be as follows:

- Partial closure of affected traffic lane shall be necessary during repair work.
- Lane vehicle load will be limited during removal and reconstruction of existing diaphragm and deck slab; and stressing operation.
- Re-routing of traffic shall be necessary during removal and reconstruction of existing diaphragm and deck slab.
- Temporary full closure shall be necessary during concreting and stressing operation.

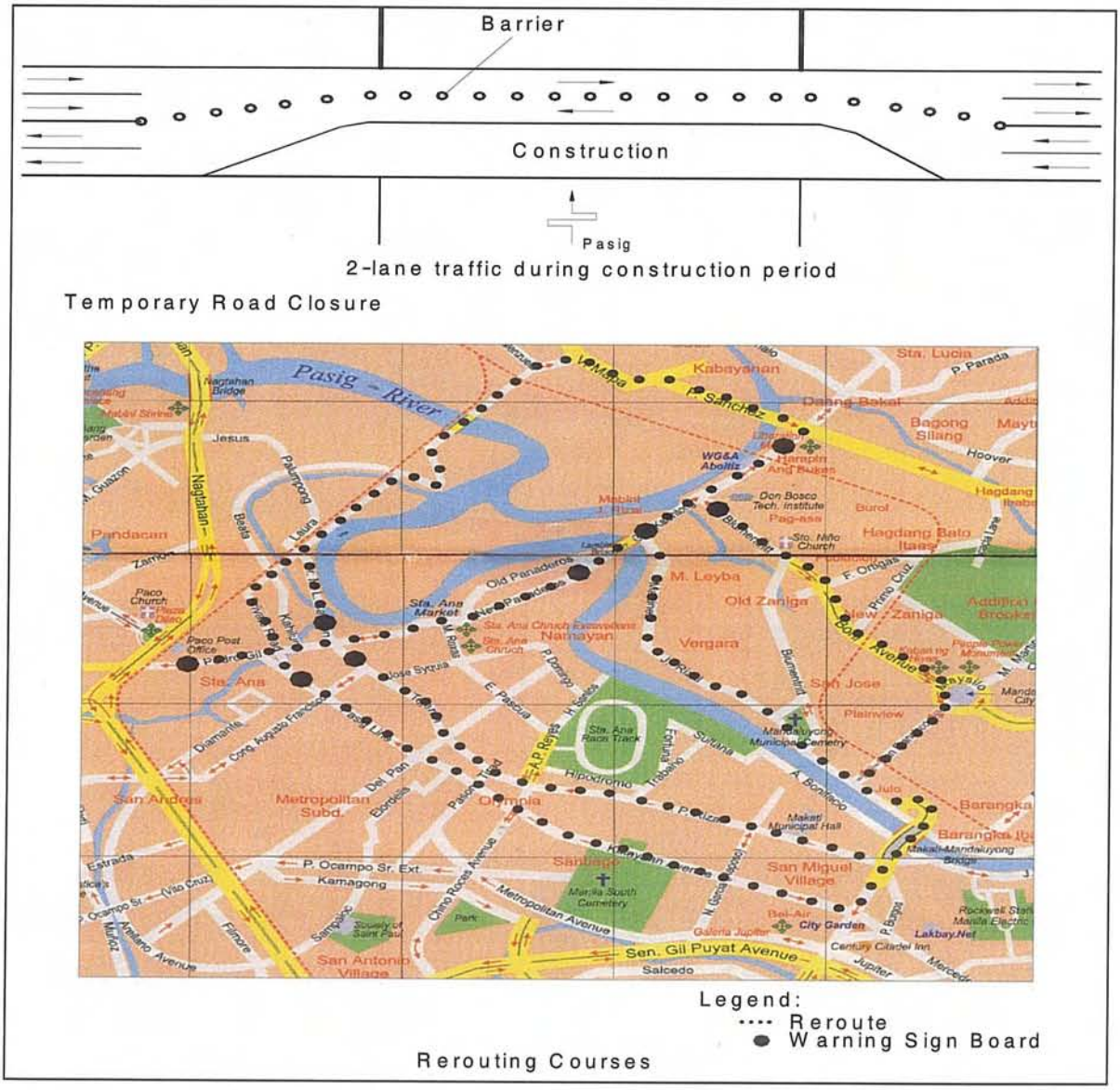


Figure 22.3.2-2 Control of Traffic Lanes and Rerouting Courses

22.3.3 Preliminary Cost Estimate

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

(1) Construction Cost

Construction cost was estimated by accumulating the cost of each work item which is the product of unit cost and quantity of each work. The unit costs of 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.

Unit costs were 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, a contingency of 5% was taken in account to the total construction cost.

The unit cost by construction item is shown in **Table 22.3.3-1**

Detailed computation is presented in **Appendix 22.3.3-1.**

Table 22.3.3-1 Unit Cost by Construction Items

June 2003 Prices

Item No.	Description	Unit	Unit Cost(PP)	Components (%)		
				Foreign	Local	Taxes
Annex I – CONSTRUCTION COST FOR REHABILITATION						
A. Repair/Sealing of Concrete Cracks						
SPL	Epoxy Bonding	l.s.	9,827,443.90	73%	15%	12%
SPL	Concrete Grouting	cu.m.	2,948,233.17	65%	25%	10%
B. Scaffolding (including scaffolding for painting)						
101(3)	Removal of Concrete Slab	sq.m.	500.00	65%	21%	14%
101(3)a	Removal of Diaphragm	cu.m.	575.00	65%	21%	14%
101(3)b	Removal of Asphalt	sq.m.	150.00	65%	21%	14%
301(1)	Tack Coat	ton	25,000.00	76%	10%	14%
310	Asphalt	ton	3,100.00	76%	10%	14%
405(1)a	Structural Concrete for Slab	cu.m.	4,500.00	65%	21%	14%
405(3)	Structural Concrete for New Diaphragm	cu.m.	6,000.00	65%	21%	14%
404	Reinforcing Steel Bars	kgs.	50.00	65%	21%	14%
416(1)	Prestressing Bar with Anchor	kgs.	604.27	65%	21%	14%
C. Installation of Carbon Fiber Reinforced Polymer						
SPL	Installation of CFRP – Wrap	sq.m.	7,057.19	80%	10%	10%
SPL	Installation of CFRP - Strip	l.m.	5,340.53	80%	10%	10%
D. Steel Railings						
SPL	Reconditioning Steel Railings	l.m.	1,500.00	65%	21%	14%
401(2)	Steel Railings	l.m.	12,636.69	65%	21%	14%
E. Drainage						
503(1)	Reconditioning of Clogged Drainage with Cover	each	8,204.76	65%	21%	14%
F. Gondola and Falsework						
SPL	Gondola and Falsework	l.s.	12,465,544.36	68%	18%	14%
G. Traffic Management						
SPL	Traffic Management	l.s.	2,000,000.00	71%	15%	14%
H. Contingencies						
Xxx	Contingencies	l.s.	2,162,071.10	75%	15%	10%
I. Temporary Facilities						
xxx	Facilities	l.s.	2,279,851.20	65%	21%	14%
J. Mobilization/Demobilization						
xxx	Mobilization/demobilization	l.s.	1,297,242.66	75%	15%	14%
Annex II - ROADWAY IMPROVEMENT						
Miscellaneous						
311	Concrete Median	sq.m.	272.93	65%	21%	14%
600(1)	Concrete Curb	l.m.	562.46	65%	21%	14%
612(1)	Pavement Markings	sq.m.	862.13	65%	21%	14%
xxx	Contingencies	l.s.	19,714.58	75%	15%	10%
xxx	Traffic Signal (2 intersection)	l.s.	3,000,000.00	75%	15%	10%

Total Construction Cost

The total construction cost for the bridge estimated on the basis described above is shown in **Table 22.3.3-2.**

Table 22.3.3-2 Estimated Construction Cost

June, 2003 Prices

Items		Cost(x MP)
Superstructure	Foreign	34.70
	Local	8.20
	Tax	6.10
	Subtotal	49.00
Highway	Foreign	2.50
	Local	0.50
	Tax	0.40
	Subtotal	3.40
Total Construction Cost		**52.40 MP**

(2) Road Right-Of-Way Acquisition Cost

No acquisition of Right-Of-Way for this bridge.

(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 varies 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 22.3.3-3**

Table 22.3.3-3 Estimated Engineering Cost

June, 2003 Prices

Items		Cost (x MP)
Detailed Design	Foreign	1.40
	Local	0.90
	Tax	0.30
	Subtotal	2.60
Construction Supervision	Foreign	2.30
	Local	1.50
	Tax	0.40
	Subtotal	4.20
Total Engineering Cost	**Total**	**6.80**

(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 22.3.3-4**

Table 22.3.3-4 Summary of Estimated Project Cost

June, 2003 Prices

Items		Cost (x MP)
Construction Cost	Foreign	37.50
	Local	8.70
	Tax	6.50
	Subtotal	52.40
Engineering Cost	Foreign	3.70
	Local	2.40
	Tax	0.70
	Subtotal	6.80
Grand Total	Foreign	40.90
	Local	11.10
	Tax	7.20
Grand Total		**59.20**

22.4 TRAFFIC ANALYSIS AND ECONOMIC EVALUATION

22.4.1 TRAFFIC ANALYSIS

(1) Alternative Road Networks and Bridge Plans

There are several road network plans that can be considered in relation to Lambingan Bridge. In this study, the following alternative cases of the road network for the traffic assignment are considered: (See **Table 22.4.1-1**)

Do Nothing Case (No rehabilitation Case)

2007 – 2010	No limitation of vehicle load
2011 – 2015	Limitation of vehicle load on Lambingan Bridge
2016 afterward	Full closure of Lambingan Bridge

Do Something Case (Rehabilitation Case)

2007 – 2034	No limitation of vehicle use on Lambingan Bridge
2035 afterward	Replacement of Lambingan Bridge

Table 22.4.1-1 Alternative Road Networks and Bridge Plans

Name of Bridge	Year	Do Nothing Case	Do Something Case
Lambingan Bridge	2007 – 2010	* No vehicle load limitation	* No limitation of vehicle load
	2011 – 2015	* Limitation of vehicle load	* No limitation of vehicle load
	2010 -2034	* Full closure of Lambingan Bridge	* No limitation of vehicle load
	2035 afterward	* Full closure of Lambingan Bridge	* Replacement of Lambingan Bridge

(2) Traffic Assignment Method

The traffic assignments to road networks with the Bridge Plans were made using STRADA highway – type assignment model as shown in **Section 5.3** in **Chapter 5**.

(3) Results of Traffic Assignment

(a) Traffic Demand Forecast on Lambingan Bridge

Tables 22.4.1-2 and 22.4.1-3 shows the traffic demand forecast on bridges on Pasig River.

Table 22.4.1-2 Traffic Demand Forecast on Bridges of Pasig River by Alternative Cases

Unit: PCU/Day

		Do Nothing Case		Do Something Case	
		2010	2020	2010	2020
6	Nagtahan Bridge	85,000	145,100	74,900	114,000
7	Pandacan Bridge	33,900	46,900	14,300	28,900
8	Lambingan Bridge	0	0	46,500	86,800
9	Makati-Mandaluyong Bridge	40,100	87,500	27,900	61,700
6	Nagtahan Bridge	85,000	145,100	74,900	114,000
Total		159,000	279,500	163,600	291,400

Table 22.4.1-3 Traffic Demand Forecast on Lambingan Bridge

Unit: PCU /Day

	2002	2010	2020	2010/'02	2020/'10
Lambingan Bridge	31,973	46,500	86,800	4.8	6.4

(b) Limitation of Vehicle Load

The vehicle load limitation for large bus and truck traffic on Lambingan Bridge was assumed to apply in this study. (See **Table 22.4.1-4**).

Table 22.4.1-4 Vehicle Load Limitation on Lambingan Bridge

	2002		2010	
	Traffic Volume	%	Traffic Volume	%
Car	20,695	64.7	30,090	64.7
Jeepney	9,732	30.4	14,130	30.4
Large Bus	32	0.1	50	0.1
Truck	1,514	4.8	2,230	4.8
Total	31,973	100.0	46,500	100.0

22.4.2 Economic Evaluation

(1) Presumptions

(a) Evaluation Period

The evaluation period is assumed to be 40 years from 2007 to 2047.

(b) Implementation Schedule of the Project

According to the implementation schedule mentioned in the previous sections, the project will be implemented with the following schedule:

- Detailed engineering 2006
- Implementation 12 months in 2007
- Open to traffic 2008

(c) Economic Indicator

The economic evaluation of the project principally employed the benefit cost analysis which is the evaluation of investment efficiency through comparison between benefits and costs derived from with and without the Lambingan Bridge rehabilitation project.

It is expressed as the benefit cost stream during evaluation period with the following economic indicators used in this study:

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

(d) Discount Rate

The discount rate is assumed to be 15 %.

(2) Project Cost

(a) Project Cost

The project cost, which is already calculated in the previous section, is expressed as the financial cost. It is therefore necessary to convert from financial cost to economic cost using the conversion factor.

In this study the economic cost is only estimated by deducting from financial costs the government taxes and is shown in **Table 22.4.2-1**.

Table 22.4.2-1 Economic Cost Estimate

Million Pesos

Description		Economic Cost	Financial Cost
1	Rehabilitation Cost		
1-1	Superstructure	42,900	49,000
1-2	Substructure	3,000	3,400
2	Consultancy		
2-1	Detailed Design	2,300	2,600
2-2	Construction Supervision	3,800	4,200
	Total	52,000	59,200

(b) Maintenance Cost

According to the maintenance data gathered in this Study the present maintenance cost for the bridges in the Metro Manila are estimated to be about 1.0% of the replacement cost. In this

study, therefore, the maintenance cost of the Lambingan Bridge is assumed to be 1.0% of the replacement cost.

(3) Economic Benefits

(a) Type of Benefit

The most significant benefit of the bridge rehabilitation project is reduction of traffic cost which consists of the vehicle operating cost (VOC) and the travel time cost (TTC). The VOC can be further sub-divided into the two (2) types: vehicle running cost (VRC) and vehicle fixed cost (VFC):

The benefit is estimated through "with and without" comparison of the traffic costs derived from the situations showing in **Table 22.4.2-2 (a and b)**.

Table 22.4.2-2 (a) Vehicle Kilometers with and without the Project

Unit: 000 PCU.-km

Year	W/O Project	W/ Project	W/O – W/
2006	-	-	-
2010	51,402	51,393	9.3
2020	69,397	69,380	17.4

Table 22.4.2-2 (b) Vehicle Hours with and without the Project

Unit: 000 PCU.-hr

Year	W/O Project	W/ Project	W/O – W/
2006	-	-	-
2010	2,066	2,065	0.6
2020	3,778	3,776	1.2

(b) Basic Vehicle Operating Cost

The basic vehicle operating cost (BVOC) is estimated annually by PMO-FS Office in DPWH. The latest BVOC was estimated in April 2002. In this study, this VBOC with some modification by inflation between April 2002 and April 2003 is utilized in this study. (See **Table 22.4.2-3**).

Table 22.4.2-3 Basic Vehicle Operating Cost (Excluding Tax)

Vehicle Type	Running (P/1000km)	Fixed [P/Min]	Time [P/Min]
Car /Taxi / Jeep	4,441	0.245	0.991
Jeepney	2,991	1.181	1.468
Bus	7,453	1.794	5.561
Track	9,622	2.107	0
Motor Cycle	822	0.082	0.586

Source: PMO-FS, DPWH
Note: BVOC prepared by PMO-FS is modified with inflation rate.

(c) Benefit Calculation

Saving in vehicle operating costs and travel time cost were estimated and are shown in **Table 22.4.2-4** (**a** and **b**).

Table 22.4.2-4 (a) Estimation of Benefits due to Vehicle Load Limitation

Unit: '000 Pesos / Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2010	1,890	688	2,578	1,821	4,399
2020	3,535	1,285	4,820	3,398	8,217

Note: Above benefits are applied during 2011 and 2015.

Table 22.4.2-4 (b) Estimation of Benefits due to Lambingan Bridge Closure

Unit: '000 Pesos / Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2010	23,170	8,427	31,597	22,288	53,885
2020	43,260	15,731	58,991	41,604	100,595

Note: Above benefits are applied after 2016

(4) Economic Evaluation

(a) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimations, the economic analysis of the Project was made. **Table 22.4.2-5** shows the results of benefit – cost analysis of the Lambingan Bridge Rehabilitation Project during project life period. The results of the economic analysis show that a Net Present Value (NPV) of P 55.6 million and BCR of 2.20 over 30 years life of the Bridge using a discount rate of 15% which is designated by the NEDA. The Economic Internal Rate of Return (EIRR) was compiled at 22.5 %. **Table 22.4.2-6** shows the benefit cost stream.

Table 22.4.2-5 Economic Indications of Benefit Cost Analysis

Net Present Value	₱55.6 million Pesos
BCR	2.20
EIRR	22..5 %

Notes: 1) Project life is assumed to be 30 years
2) Discount rate is 15%

(b) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of costs and benefits. **Table 22.4.2-7** shows the results of the sensitivity analysis.

Table 22.4.2-6 Benefit – Cost of Lambingan Bridge Medium Scale Rehabilitation Scheme

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
2	2005	0	0.0	0.0	0.0	0.0
3	2006	2,300	0.0	2,300.0	0.0	-2300.0
4	2007	49,700	0.0	49,700.0	0.0	-49700.0
5	2008	0	2,730.0	2,730.0	0.0	-2730.0
6	2009	0	2,730.0	2,730.0	0.0	-2730.0
7	2010	0	2,730.0	2,730.0	0.0	-2730.0
8	2011	0	2,730.0	2,730.0	4,682.5	1,952.5
9	2012	0	2,730.0	2,730.0	4,984.3	2,254.3
10	2013	0	2,730.0	2,730.0	5,305.5	2,575.5
11	2014	0	2,730.0	2,730.0	5,647.4	2,917.4
12	2015	0	2,730.0	2,730.0	6,011.4	3,281.4
13	2016	0	2,730.0	2,730.0	52,238.0	49,508.0
14	2017	0	2,730.0	2,730.0	55,604.7	52,874.7
15	2018	0	2,730.0	2,730.0	59,188.4	56,458.4
16	2019	0	2,730.0	2,730.0	63,003.0	60,273.0
17	2020	0	2,730.0	2,730.0	67,063.5	64,333.5
18	2021	0	2,730.0	2,730.0	69,224.6	66,494.6
19	2022	0	2,730.0	2,730.0	71,455.3	68,725.3
20	2023	0	2,730.0	2,730.0	73,757.9	71,027.9
21	2024	0	2,730.0	2,730.0	76,134.7	73,404.7
22	2025	0	2,730.0	2,730.0	78,588.1	75,858.1
23	2026	0	2,730.0	2,730.0	81,120.6	78,390.6
24	2027	0	2,730.0	2,730.0	83,734.6	81,004.6
25	2028	0	2,730.0	2,730.0	86,432.9	83,702.9
26	2029	0	2,730.0	2,730.0	89,218.2	86,488.2
27	2030	0	2,730.0	2,730.0	92,093.2	89,363.2
28	2031	0	2,730.0	2,730.0	93,577.0	90,847.0
29	2032	0	2,730.0	2,730.0	95,084.8	92,354.8
30	2033	0	2,730.0	2,730.0	96,616.8	93,886.8
31	2034	0	2,730.0	2,730.0	98,173.5	95,443.5
32	2035	0	2,730.0	2,730.0	99,755.3	97,025.3
33	2036	0	2,730.0	2,730.0	101,362.6	98,632.6
34	2037	0	2,730.0	2,730.0	102,995.8	100,265.8

Discounted Benefit Cost Stream

000 Pesos

Sq	Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	1	2004	1.000	0.0	0.0	0.0	0.0	0.0
2	2	2005	1.150	0.0	0.0	0.0	0.0	0.0
3	3	2006	1.323	1,739.1	0.0	1,739.1	0.0	-1739.1
4	4	2007	1.521	32,678.6	0.0	32,678.6	0.0	-32678.6
5	5	2008	1.749	0.0	1,560.9	1,560.9	0.0	-1560.9
6	6	2009	2.011	0.0	1,357.3	1,357.3	0.0	-1357.3
7	7	2010	2.313	0.0	1,180.3	1,180.3	0.0	-1180.3
8	8	2011	2.660	0.0	1,026.3	1,026.3	1,760.3	734.0
9	9	2012	3.059	0.0	892.4	892.4	1,629.4	737.0
10	10	2013	3.518	0.0	776.0	776.0	1,508.2	732.2
11	11	2014	4.046	0.0	674.8	674.8	1,396.0	721.2
12	12	2015	4.652	0.0	586.8	586.8	1,292.1	705.3
13	13	2016	5.350	0.0	510.3	510.3	9,763.7	9,253.4
14	14	2017	6.153	0.0	443.7	443.7	9,037.3	8,593.6
15	15	2018	7.076	0.0	385.8	385.8	8,365.0	7,979.2
16	16	2019	8.137	0.0	335.5	335.5	7,742.7	7,407.2
17	17	2020	9.358	0.0	291.7	291.7	7,166.7	6,875.0
18	18	2021	10.761	0.0	253.7	253.7	6,432.8	6,179.1
19	19	2022	12.375	0.0	220.6	220.6	5,774.0	5,553.4
20	20	2023	14.232	0.0	191.8	191.8	5,182.6	4,990.8
21	21	2024	16.367	0.0	166.8	166.8	4,651.9	4,485.1
22	22	2025	18.822	0.0	145.0	145.0	4,175.4	4,030.4
23	23	2026	21.645	0.0	126.1	126.1	3,747.8	3,621.7
24	24	2027	24.891	0.0	109.7	109.7	3,364.0	3,254.3
25	25	2028	28.625	0.0	95.4	95.4	3,019.5	2,924.1
26	26	2029	32.919	0.0	82.9	82.9	2,710.2	2,627.3
27	27	2030	37.857	0.0	72.1	72.1	2,432.7	2,360.6
28	28	2031	43.535	0.0	62.7	62.7	2,149.5	2,086.8
29	29	2032	50.066	0.0	54.5	54.5	1,899.2	1,844.7
30	30	2033	57.575	0.0	47.4	47.4	1,678.1	1,630.7
31	31	2034	66.212	0.0	41.2	41.2	1,482.7	1,441.5
32	32	2035	76.144	0.0	35.9	35.9	1,310.1	1,274.2
33	33	2036	87.565	0.0	31.2	31.2	1,157.6	1,126.4
34	34	2037	100.700	0.0	27.1	27.1	1,022.8	995.7
			Total	34,417.7	11,785.9	46,203.6	101,852.3	55,648.7

Net Present Value	55,649
B/C Ratio	2.204
EIRR	22.5%

Table 22.4.2-7 Sensitivity Analysis regarding Costs and Benefits of Lambingan Bridge Rehabilitation Project (EIRR)

Unit: %

		Benefits				
		20% down	10% down	Base Case	10% up	20% up
Costs	20% down	22.5	23.7	24.8	25.8	26.8
	10% down	21.3	22.5	23.6	24.6	25.5
	Base Case	20.2	21.4	22.5	23.5	24.4
	10% up	19.3	20.5	21.5	22.5	23.4
	20% up	18.5	19.6	20.7	21.6	22.5

Note: Project life is assumed to be 30 years

(c) Summary of Economic Analysis

The implementation of the Lambingan Bridge Rehabilitation project can be justified from the national economic point of view since the economic indicators of all cases more than the over cut-off level which is considered to be 15% of EIRR in the Philippines.

22.5 ENVIRONMENTAL IMPACT ASSESSMENT

The general approach adopted in the present Study was based on the procedural flow of the Environmental Impact Statement (EIS) System prescribed under Article III of the DENR Administrative Order No. 96-37. The EIA Team followed the Participatory Impact Assessment Method (PIAM) wherein the stakeholders were involved in the conduct of the EIA through project briefings and public consultation meetings.

22.5.1 Methodology

The EIA study covered the following modules:

- Physico-Chemical Environment
  - Physiography and Geomorphology
  - Meteorology
  - Hydrology
  - Water Quality
  - Air Quality
  - Noise Level
- Terrestrial Biology
- Socio-Economics

(1) Physico-Chemical Environment

(a) Physiography and Geomorphology

The physiographical and geomorphological study for the proposed project was done through field verification of available secondary data. The information used in the preparation of this report were obtained mostly from various government offices/entities among others, the Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Bureau of Soils and Water Management (BSWM), Pasig River Rehabilitation Commission (PRRC).

(b) Water Quality

Water quality assessment along the Pasig River, Lambingan Bridge Section was performed on 24 November 2003. One sampling site was established along the Pasig River, since it is the only water body that would be possibly affected by the proposed Improvement of the said Bridge. Temperature and pH readings were accomplished on-site. Water samples were also collected and brought to the laboratory for chemical analyses. The methodology adopted to

assess the amount of BOD, COD, TSS, Oil & Grease, DO, and Fecal and Total Coliform of the samples was based on the Standard Methods for the Examination of Water and Wastewater, 20th Ed.

(c) River Sediments

Sediments obtained from Pasig River were also tested for traces of heavy metals. The samples were assessed for traces of Chromium Hexavalent (Cr+6), Cyanide (CN-), Cadmium (Cd), Arsenic (As), Lead (Pb), Mercury (Hg), and Polychlorinated Biphenyls (PCB) Arocolor 1254. The amount of Cr+6 and CN- of the river sediments were assessed by Photometry. Traces of Cd and Pb were detected through acid digestion and quantitation by Atomic Absorption Spectrophotometry. Arsenic and mercury were derived through Hydride Generation.

(d) Air Quality

The conduct of air quality sampling followed the standard procedure according to the prescribed methodology in the Department of Environment and Natural Resources Department Order 2000-81 (DAO). Sampling was performed within a specified time and flow rate. Total suspended particulate matter and carbon monoxide were sampled on a 1-hour averaging time, whereas, NO_2 and SO_2 were evaluated within a 30-minute time period. TSP, CO, CO_2, and NO_2 sampling was done on November 27, 2003, while SO_2 sampling was performed on December 12, 2003.

(e) Noise Level

Noise level monitoring along Lambingan Bridge was carried out on December 18, 2003. Noise level was directly measured using a standard sound level meter. Sampling location was the same as that of the air quality. Monitoring was done during the morning time, daytime, evening time, and nighttime. Three (3) readings were recorded within a 5-minute averaging time.

(2) Biological Environment

(a) Flora

Identification of the flora species encountered in the project area was done through gross morphology. This is a type of plant identification that relies greatly on the external features of both vegetative and reproductive parts, since these are easily observable. Flora guidebooks

and other related reference materials were used during the conduct of the study for verification.

(b) Terrestrial Fauna

Since the project area is situated within a city, terrestrial wildlife identification, particularly birds, was done through actual observation.

(3) Socio-Economic

(a) Public Consultation Meeting (PCM)

The EIA Team organized consultation meetings with the LGUs and families to be directly affected by the proposed rehabilitation of Lambingan Bridge. The Team ensured that all stakeholders and concerned sectors are well informed of the scheduled meetings.

(b) Consultation Meetings with the LGUs

Barangay 894 Zone 99, Punta, Sta. Ana, Manila City

The proposed Improvement of Lambingan Bridge was presented to the council of Brgy. 894 on November 25, 2003. After a brief explanation of the proposed rehabilitation project, the participants were provided the opportunity to give their perceptions about the undertaking. (Please see **Table 22.5.1-1** to **22.5.1-4**).

Photo 22.5.1-1 Consultation meeting with Brgy. Captain Mario Facundo of Brgy. 894 Zone 99.

Photo 22.5.1-2 Consultation meeting with the community leaders of Brgy. 891 Zone 98, Sta. Ana, Manila.

Photo 22.5.1-3 Meeting with the councilors of Brgy. 888 Zone 98, New Panaderos, Sta. Ana, Manila City

Photo 22.5.1-4 Consultation meeting with the Peoject-Affected Families, held under the Lambingan Bridge

22.5.2 Brief Description of Data Gathering

Baseline information for the preparation of the report was established through primary and secondary data gathering procedures. Series of field investigations, verifications, validations of information obtained from the concerned government offices/agencies visited by the EIA Team were carried out. The offices/entities include the City Government of Manila, Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), Mines and Geosciences Bureau (MGB), Bureau of Soils and Water Management (BSWM), and Philippine Institute of Volcanology and Seismology (PHIVOLCS). The Team also coordinated with the Pasig River Rehabilitation Project Commission (PRRC).

With respect to the **ambient air quality, water quality, noise level,** and **socio-economic** aspects, actual samplings and perception surveys within the study area were performed to generate baseline data.

22.5.3 Brief Description of Project Environment

The areas to be directly affected by the project are Brgy. 888 Zone 98, New Panaderos, Sta. Ana and Brgy. 892, Punta, Sta. Ana. These are located at the southwest approach of the bridge. Informal settlers residing in between the girders, at the side of the column, and those directly under the bridge are subject for relocation to accommodate the construction activities.

The indirect impact areas located at the northeast side of the Lambingan Bridge include Brgy. 894 Zone 99, Punta, Sta. Ana and Brgy. 891 Zone 98, New Panaderos, Sta. Ana. It is emphasized here that there are no affected residents in the said communities.

(1) Physico-Chemical Environment

(a) Physiography and Geomorphology

The MMA is divided into six (6) physiographic zones, namely, *Manila Bay, Coastal Margin, Guadalupe Plateau, Marikina Valley, Laguna Lowlands* and *Laguna de Bay* (Besana and Daligdig, 1993). The study area is the low-lying flat strip of land between the Manila Bay Zone on its west and the elevated Guadalupe Plateau on its eastern boundary. This is designated as the Coastal Margin zone with an average elevation of less than five (5) meters above mean sea level (amsl). This zone includes the CAMANAVA area (Caloocan, Navotas, Malabon, and Valenzuela), Pasay City, Parañaque City, Las Piñas City, the reclaimed portions of Manila Bay and the City of Manila.

The Pasig River delta plain has an average elevation of less than 5 meters, a roughly concave shape, poor drainage and gently sloping towards Manila Bay. This plain is mainly of beach and estuarine deposits in the north and in the south are lagoons and beach sediments derived from the clastics formerly and actively dumped by the Pasig River itself.

(b) Geological Setting

According to Gervacio (1968), Manila extending south to near Pasay City is within a deltaic plain formed by the Pasig River. The plain coalesced southward with the beach and lagoon deposits of Parañaque and northward with the dominantly estuarine deposits and beach and/or sand bar deposits of Caloocan City and Malabon. Previous data show that the delta materials' composition are of sand, pebbly gravel, silt, mud and clay of various colors and plasticity; in areas covered by sand, silt and clay deposits laid down by seasonal floods. The delta deposit is generally stratified to crossbedded. Inter-lobing or intertonguing of various delta material components has also been a common characteristic that was observed. The deposit is over 70 meters thick near the coast and thins out eastward in the Sta. Mesa and Makati areas. Along the eastern border zone, the deposit rests almost conformably on a firm sequence of tuffaceous rocks (Guadalupe Formation) and westward on slightly compacted, intertonguing pebbly gravel, sands and tuffaceous silts.

(c) Seismicity

In areas like the City of Manila, where it is underlain by loosely-compacted, water-saturated fine sediments, earthquakes could also cause liquefaction wherein the underlying foundation temporarily assume a semi-liquid state. Associated liquefaction effects like differential settlement, sand fountaining, lateral spreading and ground undulation may also cause damage to bridges, roads and other infrastructure.

(d) Water Quality

Results of the field measurements and laboratory analyses presented in **Table 22.5.3-1** indicate that most of the parameters assessed are within the permissible limit set by the DENR. The recorded BOD and COD levels of 5.5 mg/L and 48.9 mg/L, respectively are very well within the permissible limit. As well, the pH of the River is within the normal range. It is no longer surprising that the detected amount of fecal (30,000 MPN) and total coliform (1,600,000 MPN) exceeded the limit since the river is obviously the recipient of domestic wastes of the residents and factories along the riverbank.

Table 22.5.3-1 Physical and Chemical Properties of Pasig River Lambingan Bridge Section, Manila City

	Sampling Results	DENR Effluent Standard For Class "C" Water (DAO 34)
Sampling Station Location	• In the middle of Pasig River, below the Lambingan Bridge	
Date and Time of Sampling	1131–1146 HRS 24 November 2003 (LOW TIDE)	
Parameters		
Temperature °C	29.67	Max. 3 degrees increase
pH	7.9	6.5 - 8.5
DO, mg/L	5.3 mg/L	Min. 4–5 mg/L
COD mg/L	48.9 mg/L	100 mg/L
BOD, mg/L (5 days, 20°C)	5.5 mg/L	10 mg/L
TSS, mg/L	22.8 mg/L	Max. 30 mg/L increase
Oil and Grease, mg/L	N.D.	5.0 mg/L
Total Coliform, MPN/mL	1,600,000 MPN/100 mL	5,000 MPN/1000 mL
Fecal Coliform, MPN/mL	30,000 MPN/ 100 mL	

(e) River Sediments

Results of the analyses show that most of the parameters tested exceeded the limit set by the DENR, particularly the lead content (Please refer to **Table 22.5.3-2**). This strongly suggests that Pasig River has probably been a recipient of all sorts of chemical and industrial wastes from nearby point sources, not only from direct disposal into the river, but also from disposals to its tributaries.

Table 22.5.3-2 Pasig River Sediment Test Result, Lambingan Bridge Section, Manila City

Trace Metal/Element	Result Value	DENR Standard
Chromium Hexavalent (Cr+6)	0.19 ppm	0.05 mg/L
Cyanide (CN-)	0.29 ppm	0.05 mg/L
Cadmium (Cd)	ND	0.01 mg/L
Lead (Pb)	16.4 ppm	0.05 mg/L
Arsenic (As)	0.11 ppm	0.05 mg/L
Mercury (Hg)	0.17 ppm	0.002 mg/L
Polychlorinated Biphenyls (AROCLOR 1254)	ND	–

Note: "–" Means the standard of the substance is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources (DENR Administrative Order No. 34, Series of 1990)
ND - Not Detected

(f) Meteorology

The Port Area (MCO) in Manila is the nearest synoptic meteorological station to the Lambingan Bridge. Based on the Modified Corona's Classification, the climate in Manila

City belongs to Type I, which is characterized by the wet and the dry seasons. From December to April, the project area experiences a relatively dry period. The rainy season concurs with the Southwest Monsoon from July to September. The recorded annual rainfall in the area is almost close to **2205.4 mm**. The month of August receives the highest amount of precipitation of **486.0 mm**. As well, this month has the longest number of rainy days with **22**. From a low of **26.5ºC** in January, the mean monthly temperature in Port Area could heat up to a very high of **33.5ºC** during the month of May. The annual average mean temperature is **28.2°C**. The highest relative humidity of **81%** is felt in August, while a low of **65%** is experienced from March to April. The warmest months are from March to June.

(g) Ambient Air Quality

The relatively high TSP level of **572 µg/Ncm** recorded in the area exceeded the permissible limit set by the DENR. This may be attributed to the number of diesel-powered vehicles that crossed the bridge during the time of sampling. The concentration of CO, NO_2, SO_2 are within the DENR standard. However, level of CO_2 recorded was fairly high (Please refer to **Table 22.5.3**).

Table 22.5.3-3 Observed Ambient Air Quality Along Lambingan Bridge

Parameters	Date & Time of Sampling	Averaging Time	Concentration in µg/Ncm	
			Sampling Results	*DENR Standards*
	Sta. 1		Sta. 1	
TSP	27 November 2003 1030–1130 HRS	1 hr	572 µg/Ncm	***230***
SO_2	12 December 2003 1030–1100 HRS	30 min	4.2 µg/Ncm	***180***
NO_2	27 November 2003 1030–1130 HRS	30 min	75.5 µg/Ncm	***150***
CO	27 November 2003 1030–1130 HRS		8.5 ppm	***30 ppm***
CO_2	27 November 2003 1030–1130 HRS	1 hr	645 ppm	-

Note: "–" Means the standard of the substance is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources (DAO 34, Series of 1990)

(f) Noise Level

The values obtained along the bridge in all the sampling periods exceeded the permissible limit set by the DENR. This is probably due to the instantaneous peaks generated by the vehicles crossing the bridge at the time of sampling, particularly trucks and other diesel-powered vehicles as shown in the photos below. (Please see **Table 22.5.3-4**).

Table 22.5.3-4 Observed Noise Level Along Lambingan Bridge

			Noise Levels in dB (A)	
Time	DENR Standards		Date & Time of Monitoring	Monitoring Results
	B	C	Lambingan Bridge	Lambingan Bridge
Morning (0500–0900 HRS)	60	65	06 January 2004 0616–0622 HRS	89.03
Daytime (0900–1800 HRS)	65	70	06 January 2004 1403–1409 HRS	91.26
Evening (1800–2200 HRS)	60	65	06 January 2004 1835–1844 HRS	89.46
Nighttime (2200–0500 HRS)	55	60	06 January 2004 2202–2209 HRS	89.92

SOURCE: Rules and Regulations of the National Pollution Control Commission (NPCC), 1978

(i) Land Use

The project area is divided into two (2) different land use types. Brgy. 894 Zone 99 in Punta Sta. Ana on the southwest approach of the bridge and Brgy. 888 Zone 98 in New Panaderos are within the area intended for light industrial use. On the other hand, the prevailing land use types in Brgy. 891 Zone 98 on the northeast approach and Brgy. 892 on the other side are both located in an area classified as 2nd class commercial.

(2) Biological Environment

(a) Terrestrial Flora

The plants observed in the project area are mostly built-up type and considered minimal. It is also important to note here that the proposed improvement of Lambingan Bridge will have no significant impact to the flora environment.

(b) Terrestrial Fauna

The commonly observed species in the project area is *Collocalia esculenta* (glossy swiftlet), which is endemic to the Philippines. Other species noted are *Lanius cristatus* (brown shrike), *Sterna* sumatrana (black-naped tern), and *Passer montanus* (urasian tree sparrow). The proposed improvement of Jones Bridge is not expected to have any significant impact to the faunal environment.

(3) Socio-Economic Environment

The results of field investigation and interview surveys conducted are presented and discussed in this section. Based on site inspection, a total of **18** Project-Affected Families (PAFs) were identified. These PAFs belong to two (2) barangays, namely Barangay 888 Zone 98, and Barangay 892.

Aside from the PAFs that will be directly affected as a result of the rehabilitation of Lambingan Bridge, other stakeholders were identified and included in the survey. They are the users of the bridge, which include the drivers and passengers of (i) public utility jeepneys, (ii) private vehicles, (iii) trucks, and (iv) Mega taxis, commonly known as "FX". As such, two (2) sets of questionnaires were prepared, one for PAFs and the other for motorists. A total of **101** respondents (**15** PAFs and **86** motorists) were interviewed. **Table 22.5.3-5** shows the number of PAFs and motorists interviewed.

Table 22.5.3-5 Number of Stakeholders Interviewed

	Number	Interviewed	%
Brgy. 888 Zone 98	14	14	100.0
Brgy. 892	4	1	25.0
Motorists	86	86	100.00
TOTAL	**104**	**101**	**97.1**

(a) Project Affected Families (PAFs)

Number and Type of Dwelling

There are two (2) main types of dwellings/structures occupied by the PAFs. These are the apartment and shanty types of dwelling. The apartments are structures made of wood and light materials, have common roofing, and are composed of several units. The shanties are made of light materials such as second hand roofing with worn materials in place, old plywood, and other small pieces of used lumber. Most of the time, the informal settlers make use of the bridge as roofing. Please see **Photo 22.5.3-1** and **22.5.3-2**.

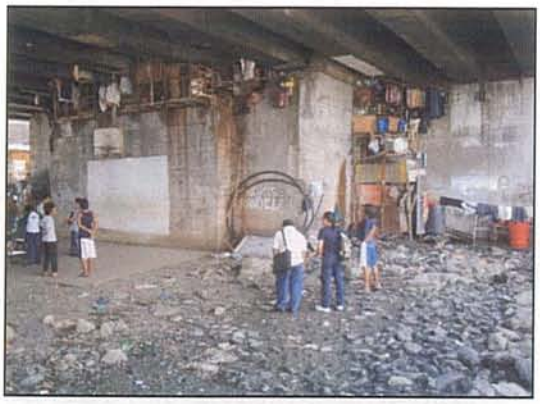


Photo 22.5.3-1 Photos showing the informal settlers' dwellings below the Lambingan Bridge columns and between the girders

Photo 22.5.3-2 Sample dwelling under the bridge at Barangay 892

Table 22.5.3-6 and **Figure 22.5.3-1** shows the number and type of dwelling of Project-Affected Families under the Lambingan Bridge.

Table 22.5.3-6 Number and Type of Dwelling of PAF's

Type of Dwellings	Frequency	Percent
Apartment	7	46.7
Shanty	8	43.3
Total	15	100.00

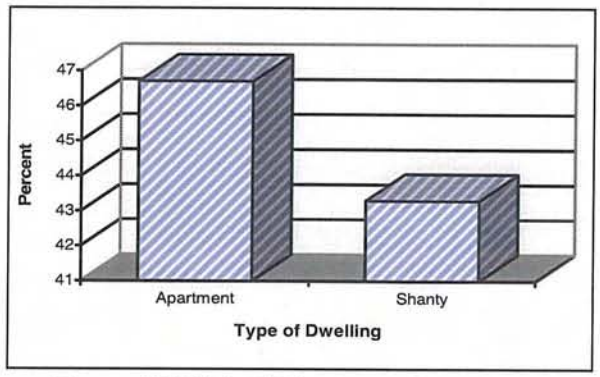


Figure 22.5.3-1 PAF's Type of Dwelling

Household Size

Majority of the PAFs have a household size of 1 to 4; and 5 to 7. Only have between 8 to 10 members. This trend is quite different from other urban areas where informal settlers abound, wherein most of the families have a minimum of 5 to 7 members (Please see **Table 22.5.3-7** and **Figure 22.5.3-2**). This trend is quite different from other urban areas where informal settlers abound, wherein most of the families have a minimum of 5 to 7 members.

Table 22.5.3-7 Household Size of Project-Affected Persons

Size	Frequency	Percent
1 to 4	7	46.7
5 to 7	7	46.7
8 to 10	0	0.0
>10	1	6.7
Total	15	100.00

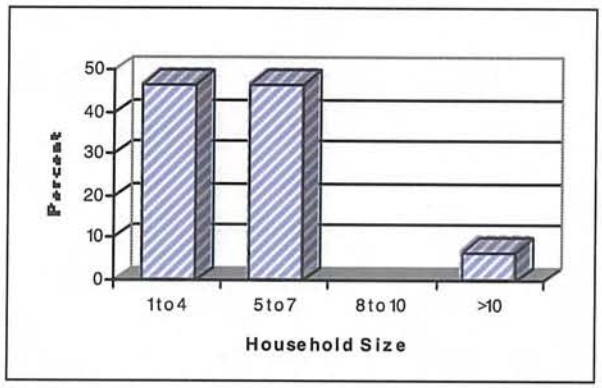


Figure 22.5.3-2 Household Size of PAF's

Household Income

In terms of household income, results show that 60% of the PAFs have annual household incomes below the poverty threshold set by NEDA, which is equivalent to P55,292 for a family of four (4). Please **Table 22.5.3-8** and **Figure 22.5.3-3)**

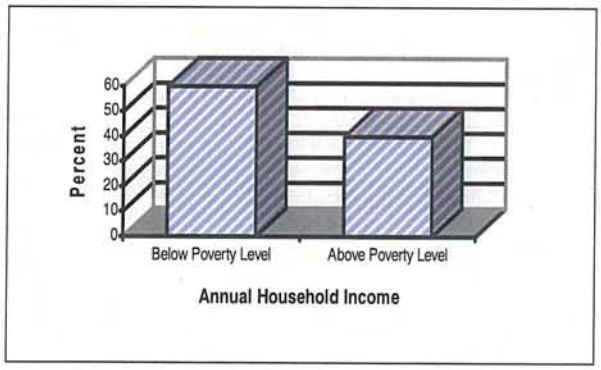


Figure 22.5.3-3 PAF's Annual Household Income

Table 22.5.3-8 Annual Household Income of

Project-Affected Persons

Income	Frequency	Percent
Below Poverty Threshold*	9	60.0
Above Poverty Threshold*	6	40.0
Total	15	100.00

Note: * - Based on the NEDA annual per capita poverty threshold as of year 2000 for a family of six (6), which is equivalent to P82,938.00

History of Residency

As shown in the results occupancy of the bridge started in the 60's and increased towards the eighties, nineties, and continued up to the 2000s. Similar to the other bridges under the present study, this trend seems ironic because it was during this decade, specifically in the year 1992 when the law (R. A. 7279) prohibiting illegal settling in danger areas such as river banks, was enacted (Please refer to **Table 22.5.3-9** and **Figure 22.5.3-4**).

Table 22.5.3-9 History of Residency of Project-Affected Persons

Year	Frequency	Percent
1960's	1	6.7
1970's	1	6.7
1980's	3	20.0
1990's	4	26.7
2000's	6	40.0
Total	15	100.00

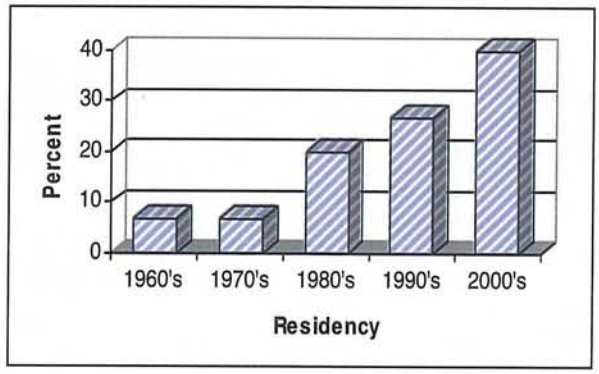


Figure 22.5.3-4 PAF's History of Residency

Availability of Basic Social Services

Another factor which was considered in assessing the socio-economic profile or status of the PAFs is their accessibility to basic social services such as drinking water, power/electricity, toilet facility, health facility, and educational facility, and as an additional indicator, their waste disposal practices. Based on the surveys, majority of the PAFs have illegal water and power connections, and do not have toilet facilities, which strongly indicate their low and miserable status of living (Please refer to **Figure 22.5.3-5 to Figure 22.5.3-7**).

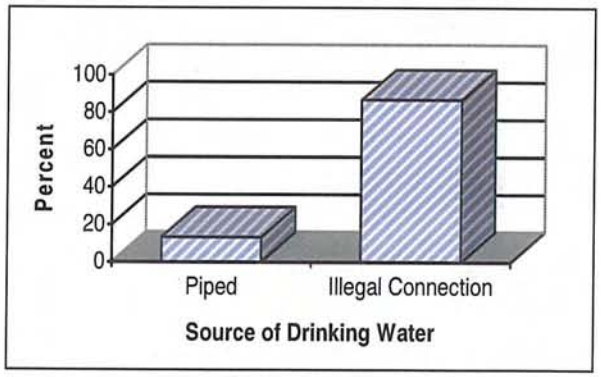


Figure 22.5.3-5 PAF's Source of Drinking Water

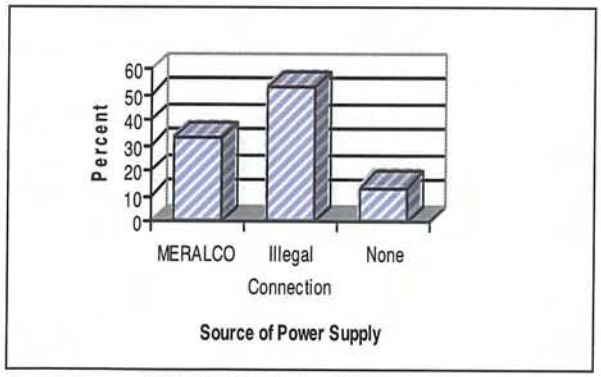


Figure 22.5.3-6 PAF's Source of Power Supply

In terms of health and educational facility, all PAFs have access to all types of health facilities such as health centers, private clinics, and hospitals. This is because they are located within one of the busiest and progressive districts of the City of Manila. In terms of waste disposal practices, all the PAFs dispose of their solid wastes through the City Garbage Collector.

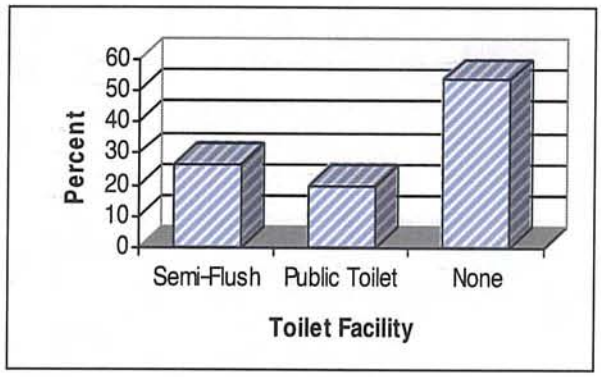


Figure 22.5.3-7 PAF's Toilet Facilities

(b) Motorists

Perceived Causes of Traffic Congestion and Condition of Lambingan Bridge

When asked about the traffic situation along Lambingan Bridge, the respondents cited their perception regarding the various causes of congestion. The answers are shown in **Table 22.5.3-10** and **Figure 22.5.3-8**.

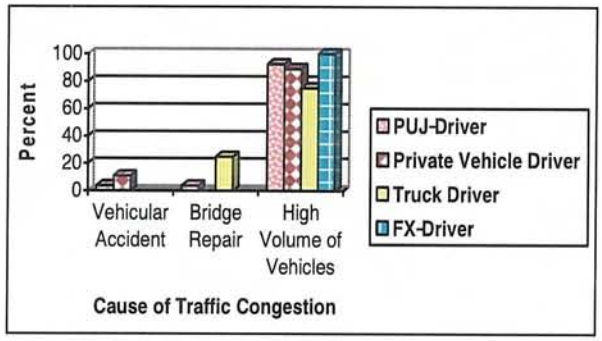


Figure 22.5.3-8 Perceived Causes of Traffic Congestion

Table 22.5.3-10 Perceived Causes of Traffic Congestion Along Lambingan Bridge

Type of Respondent	Vehicular Accident		Bridge Repair		High Volume of Vehicles		Total	
	No.	%	No.	%			No.	%
PUJ-Driver	2	3.8	2	3.8	49	92.5	53	100.0
PV-Driver	1	11.1	-	-	8	88.9	9	100.0
Truck Driver	-	-	1	25.0	3	75.0	4	100.0
FX Driver	-	-	-	-	1	100.0	1	100.0
Total	3	4.5	3	4.5	61	91.0	67	100.0

(c) Social Acceptability

Based on the interview surveys, a high **86.7%** of the PAFs, and almost **100%** of all the motorists interviewed expressed full support to the proposed improvement of the Lambingan Bridge (Please see **Table 22.5.3-11** and **Figure 22.5.3-9**).

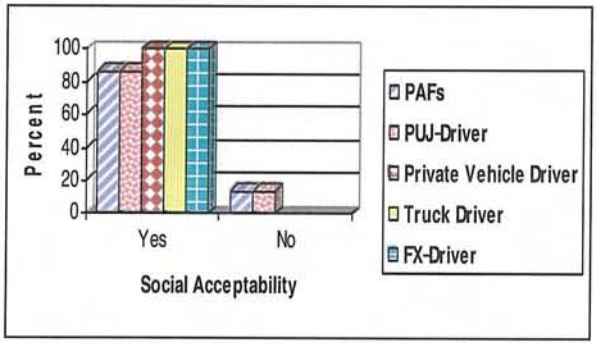


Figure 22.5.3-9 Social Acceptability of the Project

Table 22.5.3-11 Social Acceptability of the Project

Type of Respondent	Yes		No		Total	
	No.	%	No.	%	No.	%
PAFs	13	86.7	2	13.3	15	100.0
PUJ-Driver	46	86.8	7	13.2	57	100.0
PV-Driver	21	100.0	-	-	21	100.0
Truck Driver	11	100.0	-	-	11	100.0
FX Driver	1	100.0	-	-	1	100.0
Total	92	91.1	9	8.9	101	100.0

(d) PAFs' Willingness to Relocate

Based on the interviews conducted, majority of the PAFs (**73.3%** from Brgy. Caniogan and **93.8%** from Brgy. Bagong Ilog) expressed willingness to be relocated from their present dwelling areas (Please see **Table 22.5.3-12** and **Figure 22.5.3-10**).

Table 22.5.3-12 Willingness to Relocate

	Frequency	Percent
Yes	10	66.7
No	1	6.7
Not applicable*	4	26.7
Total	15	100.00

Note: Have been previously awarded relocation sites in Cavite but went back to the bridge

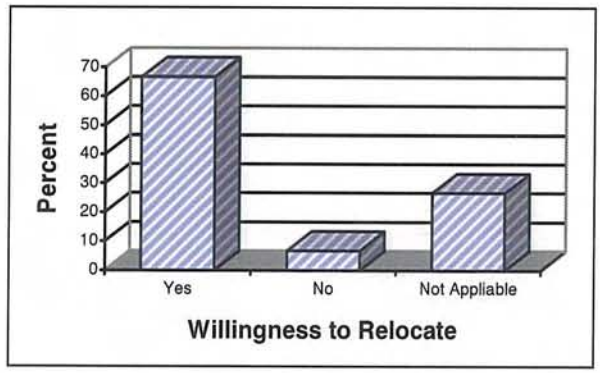


Figure 22.5.3-10 PAF's Willingness to Relocate

(e) PAFs' Preferred Relocation Site

When asked about their preferences regarding the relocation site, a high **60.0%** percent of the PAFs responded that they would prefer a relocation site within the City of Manila. Only a few favored any other relocation site (Please refer to **Table 22.5.3-13** and **Figure 22.5.3-11**)

Table 22.5.3-13 Preferred Site

Site	Frequency	Percent
Relocation w/in the City	9	60.0
Cavite	1	6.7
Not applicable*	5	33.3
Total	15	100.00

Note: Have been previously awarded relocation sites in Cavite but went back to the bridge

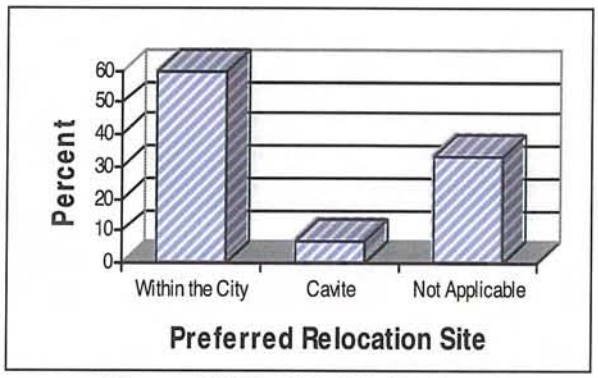


Figure 22.5.3-11 PAF's Preferred Relocation Site

(f) Resettlement Requirements

The rehabilitation works along Lambingan Bridge would entail displacement of **18** informal settlers occupying the portions under and along the sides of the said bridge. Although the work involved would be mainly the rehabilitation of gerber hinge parts, it is important to ensure the safety of these people once the construction activities commence.

To accomplish this, Resettlement Action Plan (RAP) has to be prepared and implemented for the Project-Affected Families residing at various sections of the bridge. Under the Implementing Rules and Regulations (IRR) of Section 28 of the same Act (R.A. 7279), it is not only the LGUs' responsibility to relocate project affected persons or families. Section 2 of the said IRR states that one of the conditions for demolition to be allowed is when government infrastructure projects with available funding are about to be implemented. Section 3 of the same IRR states that relocation operations shall be the responsibility of the LGU concerned or the government agency authorized to demolish. In any case, coordination between the DPWH and the City Government of Manila would be extremely necessary for the resettlement plan to be successfully carried out.

22.5.4 Impacts and Mitigation Measures

The predicted impacts and corresponding mitigation measures are presented in **Table 22.5.4-1**. The Environmental Management and Monitoring Program is shown on **Table 22.5.4-2**.

Table 22.5.4-1 Impacts and Mitigation Matrix

Parameters to be Monitored	Impacts	Duration and Degree of Impacts	Mitigating/Enhancement Measures
REHABILITATION PHASE PHYSICAL ENVIRONMENT			
Hydrology & Water Quality	Possible increase in the turbidity due to the movement and positioning of construction barges that will create eddies thus disturbing river sediments at the shallow portion of the Pasig River	Short-term, negative	• The impact is unavoidable but temporary in nature. Condition of the Pasig River is expected to return to normal as soon as the rehabilitation works are completed
	Possible impediment of river flow due to indiscriminate disposal of replaced steel structures	Short-term, negative	• Replaced steel structures must be properly stockpiled and regularly hauled to the designated disposal site to avoid impediment of river flow
	Possible increase in the level of oil and grease and other waste contaminants in the river	Long-term, negative	• Contractors will be required to conduct daily routine check up of heavy equipment and machinery to ensure these are in good working condition to avoid spillage of oil and grease into the River and prohibited from washing the construction equipment along the River to prevent further contamination of the waterway
	Possible increase in level of chemical pollutants due to the painting and cleaning of corroded steel floor systems	Long-term, negative	• Safety nets or tarpaulin materials must be installed below the Lambingan Bridge during painting and cleaning of corroded steel floor systems to prevent spillage of paints and other chemicals into the River that may further pollute the waterway
Air Quality & Noise Level	Possible increase in exhaust gas emission levels	Short-term, negative	• Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions; and • Regular tune-up and maintenance of construction equipment and machinery will be complied with to minimize exhaust gas emissions
	Possible increase in existing noise level along Lambingan Bridge and its immediate vicinity	Short-term, negative	• Noise suppressors, such as mufflers will be installed whenever deemed necessary to maintain the noise generated by the various heavy equipment and other construction machinery to permissible limits; and • High noise generating construction activities will be scheduled during daytime to minimize disturbance to the residents surrounding the area
REHABILITATION PHASE SOCIO-ECONOMIC ENVIRONMENT			
Human Settlement	Displacement of informal settlers on the side and under the northeast approach of Lambingan Bridge	Long-Term, negative	• Relocation of affected informal settlers in close coordination with the City Government of Manila
	Opportunity for 18 Project-Affected Families (PAFs) to be resettled and thus enjoy security of tenure and access to basic social services	Long-Term, positive	• Ensure that relocation and resettlement procedures are in accordance with international (World Bank and JBIC) and local policies and thus protect the interest of these PAFs, and ensure that their lives are not worsened off by the proposed project.
Income of Drivers	Possible decrease in the earnings of public transport drivers due to traffic congestion	Short-Term, negative	• This impact is unavoidable but temporary in nature. A sound traffic management re-routing plan duly-approved by the Metro Manila Development Authority (MMDA) will be implemented to minimize the effect of traffic congestion during implementation of the project, in which a two-way two-lane traffic management scheme will maintained to avoid traffic congestion within the construction site
Safety	Hazard to motorists using Lambingan Bridge	Short-Term, negative	• Traffic enforcers and flagmen will be designated at critical construction sites to ensure safety of motorists; • Illuminated warning signs, lighting, and barricades will be installed along the entire stretch of Lambingan Bridge;
Employment	Generation of temporary employment for qualified laborers within the affected areas during the construction	Short-Term, positive	• Qualified workers and laborers from the affected barangays will be given priority in hiring during the construction stage of the project
OPERATION PHASE SOCIO-ECONOMIC ENVIRONMENT			
Safety	Improved safety of motorists crossing Lambingan Bridge	Long-Term, positive	• Inspection and maintenance of the newly rehabilitated bridge will be done on a regular basis to ensure optimum level service to road users

Table 22.5.4-2 Environmental Monitoring Program Matrix: Rehabilitation Stage

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standards	Implementor
PHYSICAL					
Water Quality BOD, TSS, Oil & Grease	Pasig River	Twice a year during construction period	Standard DENR EMPASS-EQD water quality analysis.	Class "C" **BOD - <10 mg/L** **TSS- <30 mg/L increase** **Oil & Grease - <3mg/L**	DENR-NCR
Air Quality TSP, NO_2, and SO_2	Lambingan Bridge	Twice a year during construction period	Standard EMPASS-EQD water quality analysis.	TSP – 300 µg/Ncm^3 NO_2 – 470 µg/Ncm^3 SO_2 – 375 µg/Ncm^3	DENR-NCR
Noise Level	Lambingan Bridge	Twice a year during construction period	Standard EMPASS-EQD water quality analysis.	Morning – 65 dB(A) Daytime – 70 dB(A) Evening – 65 dB(A) Nighttime – 60 dB(A)	DENR-NCR
SOCIAL					
Compliance of Contractor to occupational health and safety rules and regulation	Within the construction site	Daily	Site inspection of work areas including sanitation facilities	Based on EMP	DENR-NCR
Safety of motorists using Lambingan Bridge	Lambingan Bridge	Daily	Regular site inspection within the construction area	Based on DPWH and PCG Standard Operating Procedures	DPWH
Structural Integrity of the Lambingan Bridge	Lambingan Bridge	Based on standard DPWH maintenance procedures	Standard DPWH bridge maintenance works	Based on DPWH Standard Operating Procedures	DPWH