PART IV FEASIBILITY STUDY OF SELECTED BRIDGES

19. SECOND AYALA BRIDGE

JUSTIFICATION OF BRIDGE

Traffic Function

Through a series of consultations and discussions with agencies concerned, it was recommended to adopt improvement works for the Ayala Bridge that would maintain its existing configuration. It is a requirement that the existing Ayala Bridge configuration shall not be altered due to its historical heritage and value.

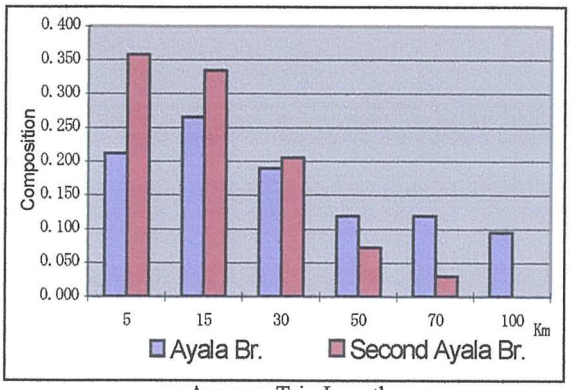
However, the traffic volume on the bridge was forecasted to be beyond its capacity in near future. Related to this, the second Ayala Bridge is proposed to improve the traffic plan in the vicinity area, being expected to play a role as a complement to the traffic function of the existing Ayala Bridge.

Traffic Demand Forecast in 2010 and 2020

Bridge Name	Ayala Bridge		Second Ayala Bridge	
	Traffic Volume (PCU)	Growth Rate (%)	Traffic Volume (PCU)	Growth Rate (%)
2010	33,000	-	22,600	-
2015	41,000	4.4	27,700	4.1
2020	51,000	4.4	33,900	4.1

Traffic Characteristics

- Longer distance traffic passes through the Ayala Bridge since the road network linking with the Ayala Bridge is defined as a major arterial, and
- The Second Ayala Bridge will mainly serve the local traffic due to the bridge location and road network condition.



Average Trip Length

PROPOSED ROUTES

Three (3) routes were prepared as possible alternative routes, two (2) routes of which cross over the Pasig River between Ayala Bridge and Nagtahan Bridge, while the other going through the down stream side of Ayala Bridge.

Description of the Routes

Route	Description	Total Length
Route-1	•Connecting between Mendiola Ext. and Mendiola. •Crossing over the Malacañang Park and Malacañang Palace.	710 m.
Route-2	•Connecting between United Nations Ave. and Dr. J P Laurel.	830 m.
Route-3	•Connecting Marcelino and Carlos Palanca Sr.	410 m.

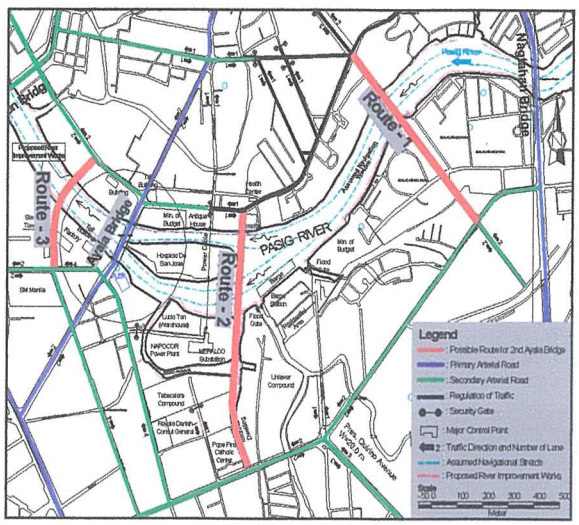
Evaluation Criteria

The following three (3) items were taken into consideration for the evaluation of the possible route alternatives.

- Social Environmental Impact
- Traffic Function
- Interview Survey Result

Selected Route

The DPWH Steering Committee eventually recommended Route 3 as the preferable route to complement the traffic function of the existing Ayala Bridge, avoiding Malacañang Area.



Possible Routes

TRAFFIC FORECAST

Traffic Survey

A survey on traffic movements at eight (8) intersections was conducted:

- To estimate the possible traffic volume on the proposed second Ayala Bridge, and
- 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.

Procedure for Traffic Analysis

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.

Calibration of OD Matrix in Manila City Area

The OD matrix in Manila City Area was calibrated by comparing between observed traffic volume and assigned traffic volume on road links and intersections.

Congestion at Intersections

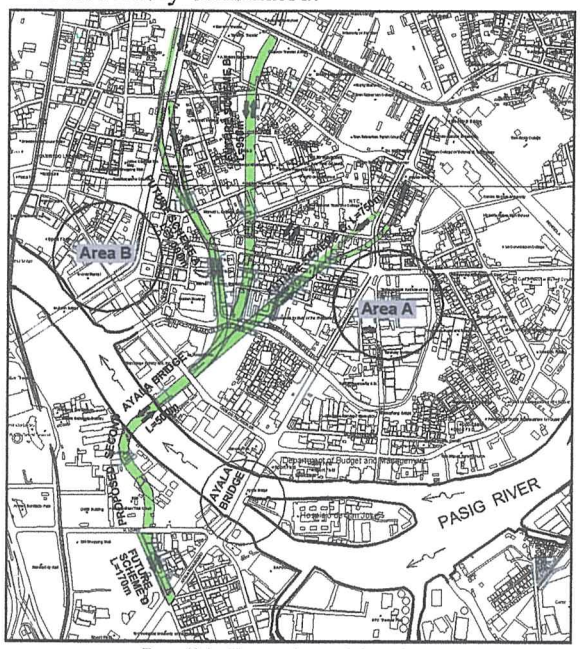
Through the construction of the Second Ayala Bridge, both sides of the intersection of the bridge will be improved:

- North Side, E to C (LOS in 2010)
- South Side, D to C (LOS in 2010)

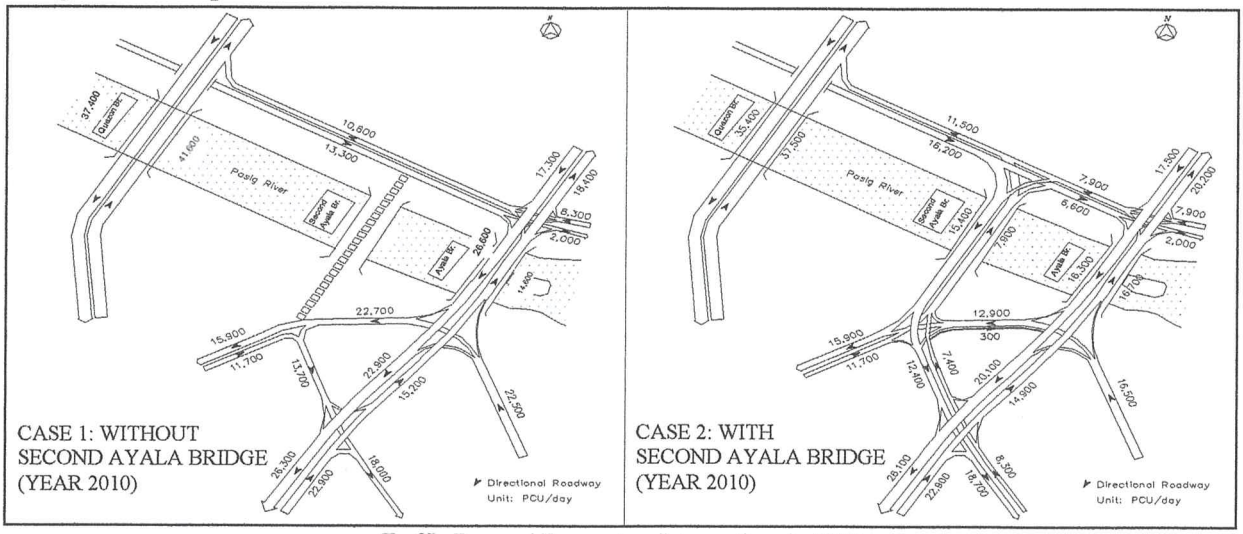
FUTURE EXTENSION OF ROUTE

The recommendation of the possible extension corridor alternatives for the route 3 for further improvement of traffic function in the vicinity was proposed

- Manila has a plan to redevelop the areas where proposed extension corridor goes through, including new road construction.
- Extension of the route is to be in conformity with Manila City Plan according to interview survey with City officials.
- By providing extension road, traffic congestion in the areas A and B may be considerably eliminated.



Possible Extension of Corridor



Traffic Demand Forecast on Intersections in 2010

PRELIMINARY DESIGN

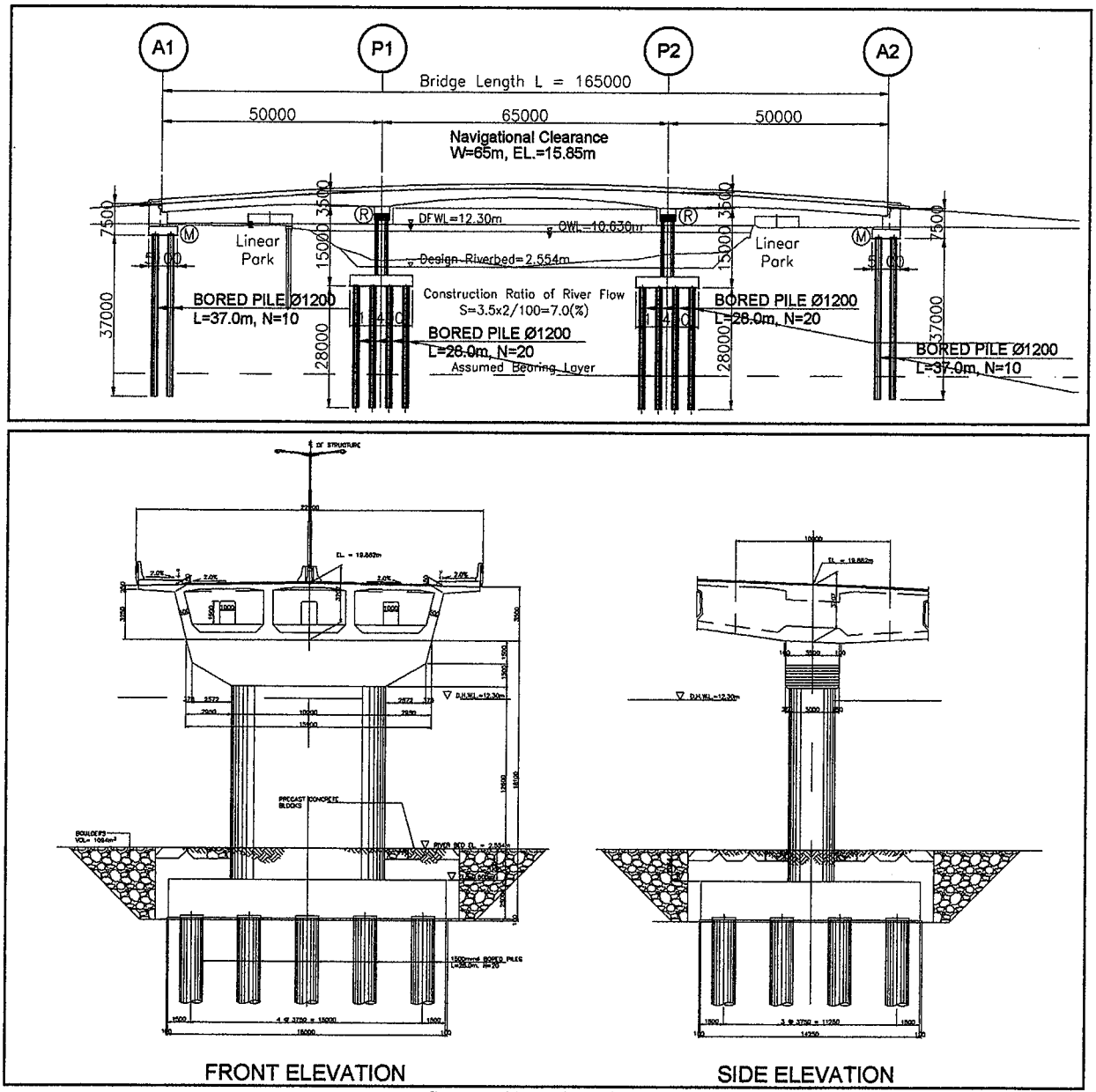
Superstructure

- The center span length is set at 65 meters to maintain an ideal navigational width of 60 meters. Also, the girder elevation at any portion of the bridge satisfies the vertical required navigation clearance.
- The side span length of 50 meters was determined in ratio of 1.0 to 1.3 of side span and center span.
- The total bridge length is 165 meters as shown below. The 3-box girder type of section was adopted since the width of bridge is 20 meters and one of the side spans is curved.

Substructure

The substructures of the bridge consists of the following structural components:

- Wall Type bridge pier with cast-in-place concrete bored pile was employed for main pier.
- Reversed T type abutment with cast-in-place concrete bored pile was adopted for Abutment
- Mechanically stabilized earth (MSE) retaining wall system along approach road for the retaining wall



Structural Drawing of Main Pier

PROJECT COST

Project Cost

Items	Cost (Million Pesos)	
Construction Cost	Foreign	427.42
	Local	129.50
	Tax	90.70
	Sub-Total	647.62
Right of Way Cost	Foreign	-
	Local	171.00
	Tax	19.00
	Sub-Total	190.00
Engineering Cost	Foreign	57.00
	Local	36.30
	Tax	10.40
	Sub-Total	103.70
Project Cost	Total	941.32

IMPLEMENTATION SCHEDULE

Based on the first year Benefit-Cost Analysis, the optimum timing of the project completion is recommended to be Year 2010.

ECONOMIC EVALUATION

- The result of the economic analysis shows that 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%.

Results of Benefit – Cost Analysis

Net Present Value	₱ 965million
Benefit Cost Ratio	2.192
EIRR	22.3%

- It can be judged that implementation of the Second Ayala Bridge can be justified from view of national economic points, since the economic indicator of the Project are over cut-off level designated as 15% by NEDA.

ENVIRONMENTAL IMPACT ASSESSMENT

- Consultation meetings with concerned government agencies such as the City Government of Manila through its City Planning and Development Office (CPDO), and the National Historical Institute were held to ensure that the Project will be in accordance with their future plans.

- Based on the consultation meeting with the National Historical Institute (NHI), it was learned that there are no historical monuments/sites within the alignment corridor, so that NHI does not have any objection to it and in fact supports the project.

- The areas within the ROW of the bridge are Brgy. 647 Zone 67 along Carlos Palanca Sr. St., San Miguel and Brgy. 659-A Zone 71 along Natividad Lopez St., in Ermita. In both barangays, several abandoned buildings and warehouses will be displaced, including three (3) residential houses within the compound of MWSS (Maynilad) on the southwest bank of Pasig River and a commercial building along N. Lopez St.

- There are 57 informal settlers that were identified during the conduct of the Social Condition Survey but only three (3) Project-Affected Families (PAFs) will be displaced during the construction of Second Ayala Bridge. This is because the alignment that was recommended by the Study Team is the one with the least number of persons that will be affected. Since there are only two (2) families to be relocated, provision of a relocation site will not be necessary.

- Adverse impacts such as the possible increase in noise levels, TSP levels and other air pollutants such as SO_X and NO_X due to the operation of various equipment and machinery as well as the turbidity of river water, are expected to be minimal during the construction period only.

20. JONES BRIDGE

ASSESSMENT OF EXISTING CONDITION

Superstructure

Major Damages

- Rupture of bottom flange up to 1/3 depth of web of exterior girder G1 (upstream) and sway bracing near Pier P2.
- Large lateral deformation of exterior girders on both upstream and downstream side at sections near piers of center span.
- Cracks at welded joint of main girder G7, exterior girders G1 & G8.
- Missing bolts at girders and joint connections.
- Corrosion of some portions of girders and miscellaneous members.

Causes of Major Damages

- Collision of vessels caused the deformations and ruptures of exterior girders and sway braces on the upstream and downstream sides.
- Collision of vessel are due to insufficient vertical navigation clearance which is only 3.6m near the piers.
- Corrosion of members are due to peeling off of paint and poor periodical maintenance.

Ruptured Girder due to Vessel Collision

Out-of-Plane Deformations due to Vessel Collision

Substructure

Major Damage

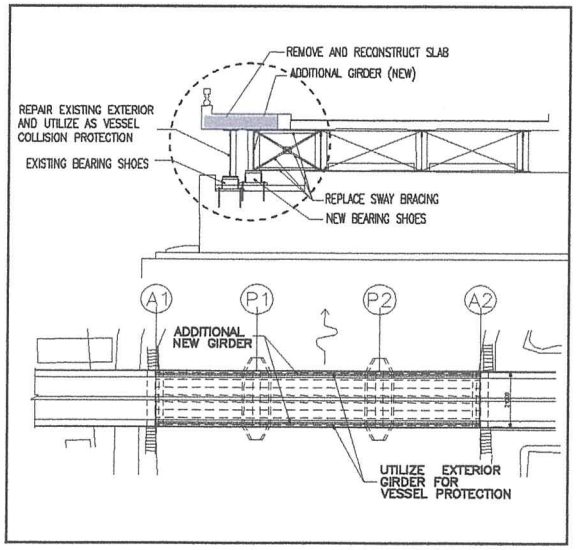
- There is no major damage observed on the substructure.

PROPOSED IMPROVEMENT MEASURES

Three (3) schemes were prepared and compared to select the best possible improvement scheme, based on several factors such as engineering and economic aspects. These were itemized as small-scale rehabilitation, medium-scale rehabilitation and large-scale rehabilitation.

RECOMMENDED MEASURE

The large-scale rehabilitation measuere was recommended as the best scheme in terms of engineering and economic aspects. Structural capacity and durability is improved. Installation of additional girder augments the capacity and stability of the superstructure and eliminates out-of-plane girder deformation. Existing exterior girder can be utilized as vessel collision protection without transmitting impact forces to the superstructure.



Scheme 3 : Large Scale Rehabilitation

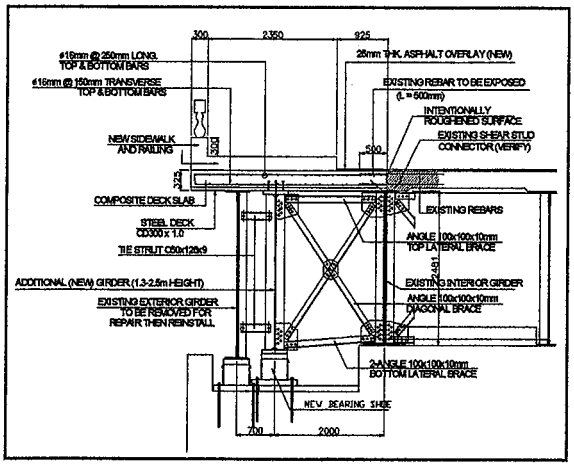
Major Works:

- Cleaning and Painting the steel structures for the whole bridge.
- Replacement of ruptured sway bracing
- Provide additional girder with new bearing shoes next to existing exterior girder
- Repair and retain existing exterior girder to functions as vessel collision protection
- Remove and reconstruct existing related portion at deck slab, sidewalk, railing and expansion joint.

PRELIMINARY DESIGN

This scheme is to retain existing exterior girder to function as vessel collision protection, installing new exterior girders adjacent to the existing exterior girder. Therefore the total width and alignment of the bridge are kept the same as the existing one.

- Additional (new) steel girders are installed next to the existing exterior girders keeping space to install new bearing shoes. The height of the new girder is shallower than the existing exterior girders.
- All sway bracings between new and existing girders are removed and replaced with new ones.
- The new deck slab is composite type with steel deck to shorten construction period. The railing shall be preserved.



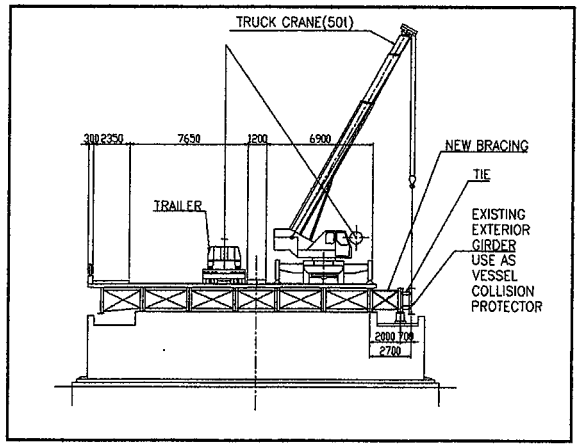
Additional Girder and new sidewalk detail

CONSTRUCTION METHOD AND TRAFFIC MANAGEMENT

After removal of sidewalk, sway bracings and installation of bearings for additional new girder, the girder is carried by trailer and erected by truck crane. Then replacement of sidewalk at upstream side follows.

The Traffic constraints are as follows:

- Only 2 lanes of the existing bridge can be used during construction,
- Vehicle load on the existing bridge will be limited during construction, and
- No provision of detour bridge during construction.



Construction Method

PROJECT COST

Estimated Project Cost Unit: Million Pesos

Construction	Engineering	Right of Way	Total
164.10	21.30	-	185.40

ECONOMIC EVALUATION

The result of the economic analysis shows that a Net Present Value (NPV) of P 235 million and BCR of 1.971 over 40 years life of the bridge using a discount rate of 15% designated by the NEDA. The Economic Internal Rate of Return (EIRR) was computed at 24.0 %.

Economic Indications of Benefit Cost Analysis

Net Present Value	₱235.42 million Pesos
Benefit Cost Ratio	1.971
EIRR	24.0 %

ENVIRONMENTAL IMPACT ASSESSMENT

- Jones Bridge encompasses two (2) barangays in Binondo, Manila, namely: Brgys. 291 on the northwest approach and Brgy. 656 on the southeast approach. No families will be displaced during the rehabilitation of Jones Bridge because there were no settlers found within the immediate vicinity of the bridge.
- Adverse impacts such as the possible increase in noise levels, TSP levels and other air pollutants such as SO_X and NO_X due to the operation of various equipment and machinery, as well as the turbidity of river water are expected to be minimal and for a short period only.

21. QUEZON BRIDGE

ASSESSMENT OF EXISTING CONDITION

Superstructure

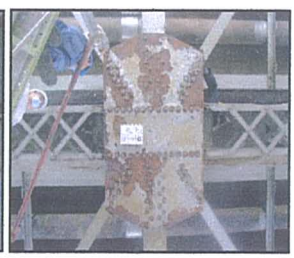
Major Damages

- Floor system mostly on gusset plates, bracing and ties are heavily corroded.
- A total of 44 joints at floor system require improvement works. There are 113 pieces of lateral braces to be cut and replaced, and at least 45 pieces of gusset plates are needed to be replaced.
- A total of 8 joints at floor system are needed to be cleaned and painted.
- Water proofing seals are needed at 51 vertical hangers to prevent water penetrating the floor system.

Causes of Major Damages

- The heavily corroded floor system are caused by the water leakage between the opening of deckslab and vertical hanger.
- The corroded stringer near the abutment are caused by water leakage from the expansion joint of slab.
- Aging of steel structures and degrading corrosion protection for steel members.
- Corrosion of member are due to peeling of paint and neglect of periodic maintenance.

Corroded Vertical Hanger



Corroded Gusset Plate

Substructure

Major Damage Description

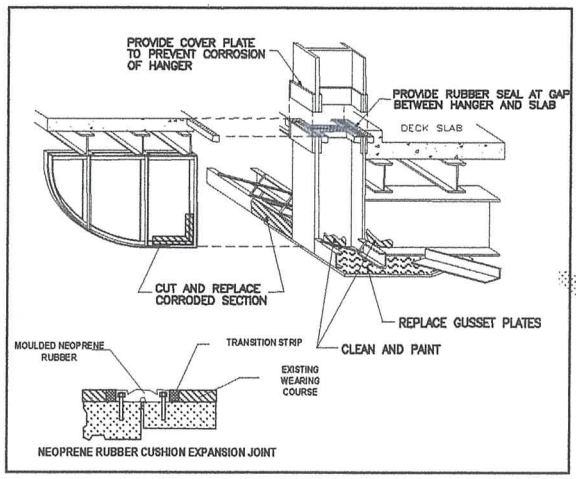
- Minor cracks on the face of the abutment.

PROPOSED IMPROVEMENT MEASURES

Three (3) schemes are prepared and compared to arrive at the best possible rehabilitation scheme, based on engineering and economic view points to provide the reasonable improvement measure. These are itemized as small-scale rehabilitation, medium-scale rehabilitation and large-scale rehabilitation.

RECOMMENDED MEASURE

The recommended alternative as best scheme in terms of engineering aspects is Scheme 2, Medium-Scale Rehabilitation. Structural capacity and durability of the bridge is improved considerably by replacing heavily corroded members and providing corrosion protection.



Scheme 2 : Medium-Scale Rehabilitation

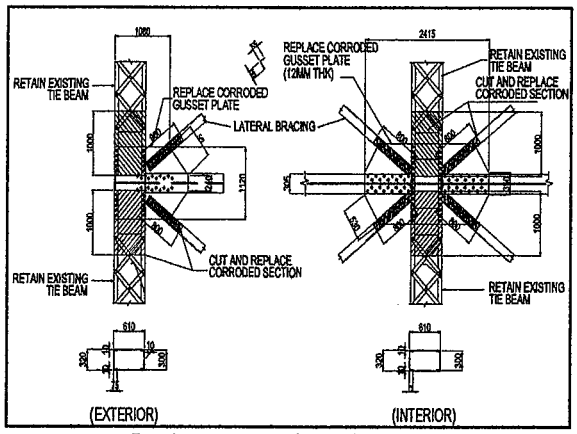
Major Works:

- Cleaning and painting floor system including corroded vertical hanger and truss.
- Replace expansion joint to seal water leakage.
- Replacement of Gusset Plates.
- Replacement of corroded section of floor beam, longitudinal tie beam and vertical members by cutting affected areas and placing new sections.
- Sealing gap between vertical hanger and sidewalk concrete and provide plates to prevent further corrosion of vertical hanger.
- Removal and reconstruction of deck slab near abutment.
- Replacement of corroded stringers near abutment.

PRELIMINARY DESIGN

The design is to replace the sections of corroded members and seal water to prevent further corrosion of the members in accordance with the inspections carried out.

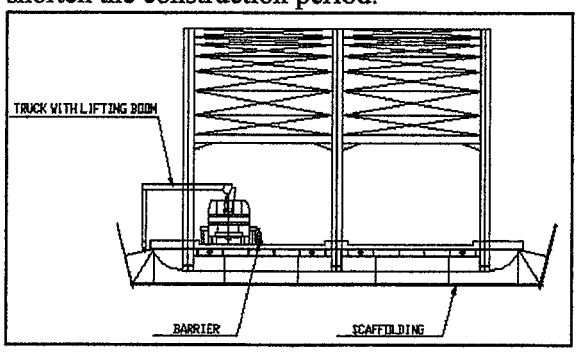
- The corroded sections of floor beams, longitudinal tie beams, and vertical hangers are replaced with the new members Sby cutting.
- Waterproof plates are welded around the vertical hanger and the gap between the plate and deck slab sealed by elastomeric rubber.
- Prevent corrosion of bearing support, by connecting new drain pipe at the existing drain pipe of deck slab.
- Expansion joint are replaced with watertight joint to prevent corrosion of floor stringer.



Replacement of Corroded Section

CONSTRUCTION METHOD AND TRAFFIC MANAGEMENT

The rehabilitation works are carried on temporary scaffolding and construction equipment are transported and lifted by lifting boom on truck. The rehabilitation works are carried out by 2 working groups in order to shorten the construction period.



Construction Method

The Traffic constraints are as follows:

- During construction of both sides vertical hanger, use 1 lane for construction and open 3 lanes for traffic.
- During construction of the middle vertical hanger, use 3 lanes for construction and open 1 lane for traffic.

PROJECT COST

Estimated Project Cost Unit: Million Pesos

Construction	Engineering	Right of Way	Total
119.60	15.60	-	135.20

ECONOMIC EVALUATION

The result of the economic analysis shows that a Net Present Value (NPV) of P 223 million and BCR of 2.81 over 40 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 computed at 34.3 %.

Economic Indications of Benefit Cost Analysis

Net Present Value	₱223 million Pesos
Benefit Cost Ratio	2.81
EIRR	34.3%

ENVIRONMENTAL IMPACT ASSESSMENT

- The area that will be covered by the rehabilitation of Quezon Bridge is composed of three (3) barangays. These are: Brgy. 384 Zone 39 and Brgy. 306 Zone 30 Quiapo, Manila, located on the northeast approach of the Bridge, and Brgy. 659, located on the southwest approach of Quezon Bridge.
- Improvement works along the bridge would entail displacement of 59 informal settlers occupying the portions under and along the sides of the said bridge. It is recommended that these informal settlers be resettled to a place where they can have security of tenure, and access to basic social services.
- Other adverse impacts such as increase in traffic congestion, noise levels, dust, gaseous pollutants, and turbidity of water are expected to be minimal, and only during the rehabilitation period.

22. LAMBINGAN BRIDGE

ASSESSMENT OF EXISTING CONDITION

Superstructure

Major Damages

- Cracks at gerber hinge.
- The outer faces of exterior girders were noted with cracks.
- Flexural cracks on girders were found above piers 1 and 2.
- Longitudinal cracks and exposed rebars were observed at midspan of the suspended girder.
- Deflection was observed on girders at center span.

Causes of Major Damage

- Cracks of gerber hinge supports were caused by insufficient hanger reinforcement provided on the girder.
- Flexure cracks found on girder sides above pier supports were caused by tension stresses at top fiber at service loads.
- The damages at the midspan of the suspended girder were caused by collision of 2.7 m high container van on top of a vessel navigating towards upstream river.
- Deflection on girders were caused by insufficient longitudinal tendons. Also, the proportioning of side span to center span is less than 0.65. This causes the uplift of girders at abutment side of side span.

Cracks on Gerber Hinge

Collision Damage

Substructure

Major Damages

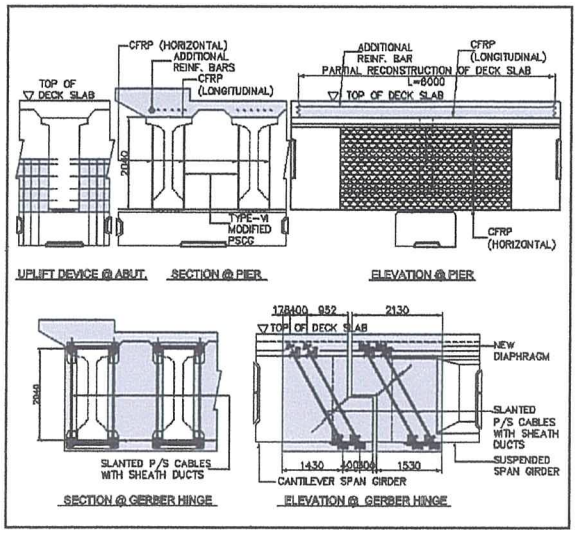
- There is no major damage observed on substructure

PROPOSED IMPROVEMENT MEASURES

Three (3) schemes are compared for the best possible rehabilitation scheme taking into consideration the engineering requirement, cost, construction difficulty, etc. These are itemized as small-scale rehabilitation, medium-scale rehabilitation and large-scale rehabilitation.

RECOMMENDED MEASURE

The recommended scheme among the three schemes is the medium-scale rehabilitation scheme. Using this scheme, it will remedy the problem of uplift at abutments. It will also improve condition of gerber by increasing the shear capacity. Flexure above pier supports will also be improved using CFRP (Carbon Fiber Reinforced Polymer)



Scheme 2 : Medium-Scale Rehabilitation

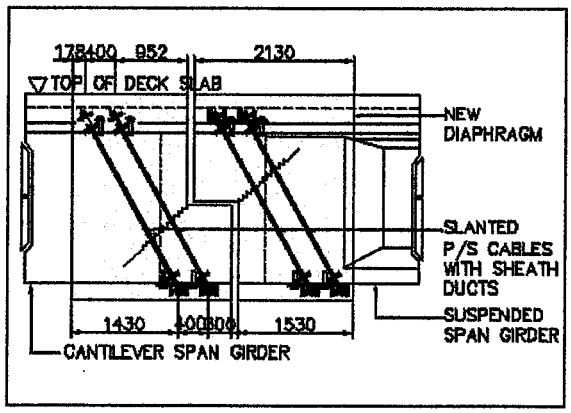
Major Works:

- Additional concrete block doweled to abutment and girder as uplift countermeasure.
- Installation of CFRP vertically at web near hinge and longitudinally at top of girder over pier support.
- Repair/Sealing of concrete cracks, honeycomb and spalling.
- Stressing of slanted prestress cables at gerber hinges.
- Reconstruction of diaphragm at gerber hinge.

PRELIMINARY DESIGN

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.

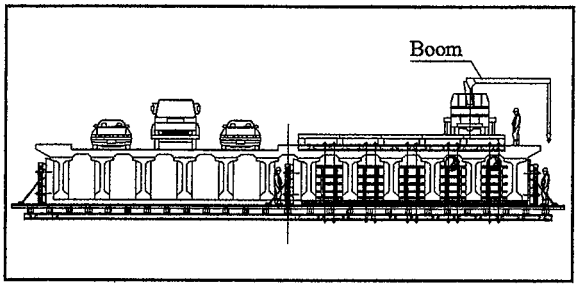
- The slanted prestressing cables are installed outside of girders. The diaphragms at gerber hinge are reconstructed with wider ones in order to distribute reactions from deck slab.
- The CFRP and additional reinforcing bars are installed outside of girder at piers to increase capacity of longitudinal negative reinforcement.
- Additional reinforcing bars with additional concrete block are installed at abutment supports in order to increase uplift capacity.



Slanted Prestress Cables Layout

CONSTRUCTION METHOD AND TRAFFIC MANAGEMENT

This rehabilitation work is partial construction of girders. All of the works are carried out on the partially provided scaffolding and the construction materials/equipments are transferred by boom crane from bridge surface to the scaffolding.



Construction Method

The traffic constraints will be as follows:

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

PROJECT COST

Estimated Project Cost Unit: Million Pesos

Construction	Engineering	Right of Way	Total
52.40	6.80	-	59.20

ECONOMIC EVALUATION

The result of the economic analysis shows that a Net Present Value (NPV) of P 55.65 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 computed at 22.5 %.

Economic Indications of Benefit Cost Analysis

Net Present Value	₱55.65 million Pesos
Benefic Cost Ratio	2.20
EIRR	22.5 %

ENVIRONMENTAL IMPACT ASSESSMENT

- 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.
- The rehabilitation works along the bridge would entail displacement of 18 informal settlers occupying the portions under and along the sides of the said bridge. It is recommended that these informal settlers be resettled to a place where they can have security of tenure, and access to basic social services.
- Adverse physico-chemical impacts such as increase in traffic congestion, noise levels, dust, gaseous pollutants, and turbidity of water are expected to be minimal, and only during the rehabilitation period.

23. GUADALUPE BRIDGE

ASSESSMENT OF EXISTING CONDITION

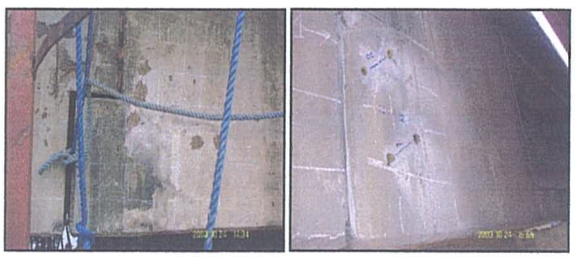
Superstructure

Major Damages

- The outer faces of exterior girders at gerber hinges have many heavy cracks which have caused a rotation in the gerber connection and abnormal vibration in the suspended span.
- The abnormal deflection have also caused flexure cracks on exterior girders at supports Pier 1 and Pier 2.

Cause of Major Damage

- Latest code requirements on gerber seat are not met.
- Insufficient flexural and shear reinforcement of gerber.



Cracks on Gerber Hinge

Substructure

Major Damages

- There are no damage observed in substructures.
- Based on the results of the analysis conducted, the existing Pier is not sound to carry the original design load and the stability of foundation is not enough to carry the load.

Cause of Major Damage

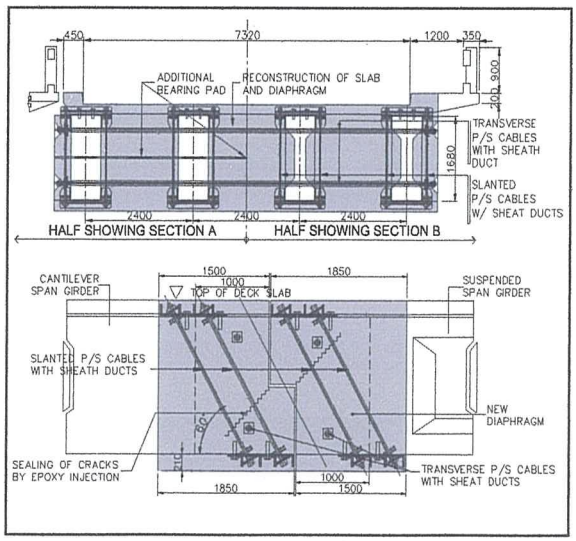
- Existing substructure cannot comply with the latest code because of the change of design requirement.

PROPOSED IMPROVEMENT MEASURES

Three (3) schemes are prepared for comparison to select the best improvement measure. The comparison is made from the several factors such as engineering, economic, traffic impact during construction, etc. These are itemized as small-scale rehabilitation, medium-scale rehabilitation and large-scale rehabilitation.

RECOMMENDED MEASURE

The recommended best scheme in terms of engineering aspects is Scheme 3 Large-scale Rehabilitation. Structural capacity and durability of the bridge will be improved considerably by providing P/S cables at gerber hinge and at the diaphragm. Construction duration for this scheme is 12 months and cost is justifiable for the overall improvement of the bridge.



Scheme 3 : Large Scale Rehabilitation

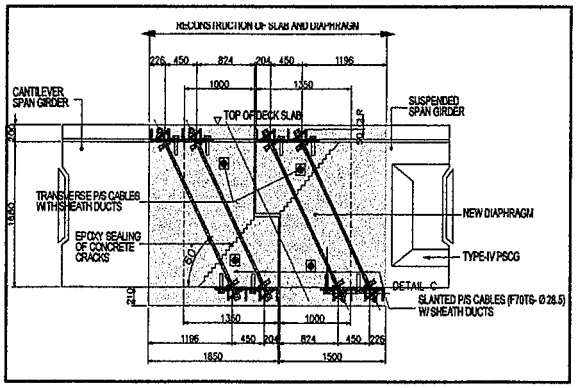
Major Works:

- Repair and sealing of concrete cracks, honeycomb and spalling.
- Rehabilitation of gerber hinge portion with slanted P/S cables.
- Reconstruction of diaphragm and partial reconstruction of deck slab at gerber hinge portion.
- Additional elastomeric bearing pads at diaphragm.
- Installation of transverse P/S cables at diaphragm of gerber hinge portion.

PRELIMINARY DESIGN

Cracks at exterior gerber hinge is the major damage of this bridge. To recover this defect, the required measures are:

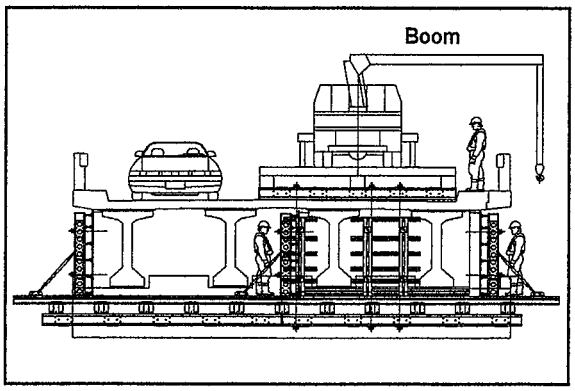
- For strengthening of gerber hinge, slanted prestressing cables are installed outside of the girder around the cracks at the hinge.
- For equal distribution of loads, the diaphragm at the hinge is widened and transversal prestressing cables are installed.
- For safety to failure of existing bearings, additional elastomeric bearing pads at diaphragm are installed.



Strengthening of Gerber Hinge

CONSTRUCTION METHOD AND TRAFFIC MANAGEMENT

This rehabilitation work is partial construction of the girders. All of the works will be carried out on the partially provided scaffolding and the construction materials/equipments are transferred by boom crane from bridge surface to the scaffolding.



Construction Method

The traffic constraints will be as follow:

- Partial closure of affected traffic lane is necessary during repair work.
- Lane vehicle load will be limited during removal and reconstruction of existing diaphragm and deck slab; and stressing operation.
- Rerouting of traffic is necessary during removal and reconstruction of existing diaphragm and deck slab.

PROJECT COST

Estimated Project Cost Unit: Million Pesos

Construction	Engineering	Right of Way	Total
20.50	2.70	-	23.10

ECONOMIC EVALUATION

The result of the economic analysis shows that a Net Present Value (NPV) of P 174.12 million and BCR of 8.59 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 computed at 41.8 %.

Economic Indications of Benefit Cost Analysis

Net Present Value	₱174.12 million Pesos
Benefit Cost Ratio	8.59
EIRR	41.8 %

ENVIRONMENTAL IMPACT ASSESSMENT

- The area to be directly affected by the project is Brgy. Barangka Ilaya in Mandaluyong City, This community is located on the north side of the bridge.
- Rehabilitation works along the Bridge would entail displacement of 18 informal settlers occupying the portions under and along the sides of the said bridge. It is recommended that these informal settlers be resettled to a place where they can have security of tenure, and access to basic social services.
- Other adverse physical and socio-economic impacts such as increase in noise levels, dust, gaseous pollutants, turbidity of water, and traffic congestion, respectively are expected to be minimal, and only for a short period during construction activities.

24. VARGAS BRIDGE

ASSESSMENT OF EXISTING CONDITION

Superstructure

Major Damages

- The outer face of exterior girders at gerber hinges were observed with cracks. The cracks were tested non-destructively to determine its extent inside the girder.
- Flexural cracks were observed on girders at pier supports
- Large deflection was noticeable affecting smooth driving condition.

Causes of Major Damage

- Cracks in gerber hinge supports were caused by insufficient hanger reinforcement provided on the girder.
- Flexure cracks of girder at top of pier 2 and pier 3 were caused by tension stresses at top fiber at service loads.
- Large deflections at the cantilever portion were due to insufficient number of longitudinal tendons. Also, the proportioning of side spans to center span are less than 0.65 which means that the tendency of the center span causes uplift to the side spans.

Cracks at Gerber Hinge

Deflection at Girders

Substructure

Major Damage Description

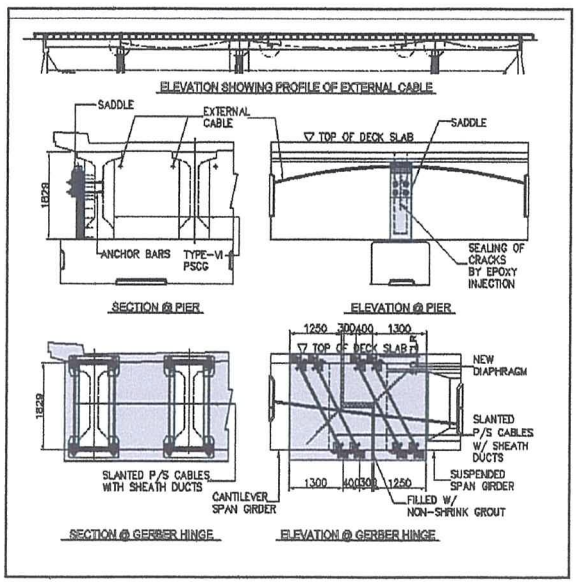
- There are no damage observed in substructures

PROPOSED IMPROVEMENT MEASURES

Three (3) schemes are prepared and compared for the best possible rehabilitation scheme based on several factors such as engineering requirement, cost, construction difficulty, etc. These are itemized as small-scale rehabilitation, medium-scale rehabilitation and large-scale rehabilitation.

RECOMMENDED MEASURE

The large-scale rehabilitation was recommended as the best scheme which propose to remedy cracks at gerber hinge with P/S cable and large deflection at the cantilever portion with external cables.



Scheme 3 : Large Scale Rehabilitation

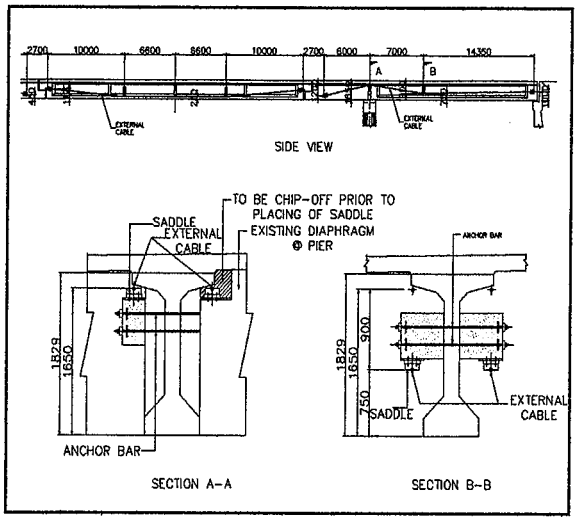
Major Works:

- Repair and sealing of concrete cracks, honeycomb and spalling.
- Installation of CFRP (Carbon Fiber Reinforced Polymer) longitudinally at top of girder and horizontally at web over pier support and horizontally at gerber hinge.
- Partial replacement of deck slab over pier support.
- Rehabilitation of gerber hinge portion with slanted P/S cables.
- Reconstruction of diaphragm and slab at gerber hinge.
- Installation of external cables on each side of the girder to counter the deflection.

PRELIMINARY DESIGN

The major damages are sagging deformation of girder and cracks at gerber hinge. To recover these defects, the required measures are:

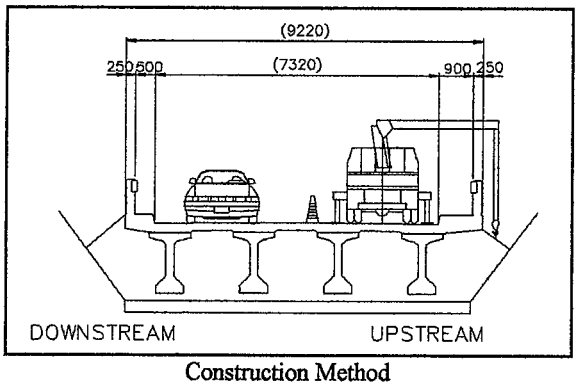
- For strengthening of gerber hinge, slanted prestressing cables are installed outside the girder around the cracks at the hinge.
- For preventing further girder deformation, external longitudinal prestressing cables are installed.



External cable for Girder Deformation

CONSTRUCTION METHOD AND TRAFFIC MANAGEMENT

This rehabilitation work is partial construction of girders. All of the works are carried out on the partially provided scaffolding and the construction materials/equipments are transferred by boom crane from bridge surface to the scaffolding.



Construction Method

The traffic constraints will be as follows:

- Partial closure of traffic is necessary during removal of existing diaphragm and partial removal of deck slab
- Temporary full closure of bridge is necessary during stressing operation and concreting works.
- Rerouting of traffic is necessary during removal and reconstruction of existing diaphragm and deck slab; and stressing operation.

PROJECT COST

Estimated Project Cost Unit: Million Pesos

Construction	Engineering	Right of Way	Total
26.10	3.40	-	29.50

ECONOMIC EVALUATION

The result of the economic analysis shows that a Net Present Value (NPV) of P 21.78 million and BCR of 1.97 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 24.1 %.

Economic Indications of Benefit Cost Analysis

Net Present Value	₱21.78 million Pesos
Benefit Cost Ratio	1.97
EIRR	24.1 %

ENVIRONMENTAL IMPACT ASSESSMENT

- The areas to be directly affected by the project are two barangays in Pasig City namely, Brgy. Caniogan and Barangay Bagong Ilog. These are located below the eastern and western foot of the bridge, respectively.
- The rehabilitation works along Vargas Bridge would entail displacement of 35 informal settlers occupying the portions under and along the sides of the said bridge.
- Other adverse physical and socio-economic impacts such as increase in noise levels, dust, gaseous pollutants, turbidity of water, and traffic congestion, respectively are expected to be minimal, and only for a short period, i.e., during rehabilitation works.

25. PROJECT IMPLEMENTATION

TIME FRAME

- Short term under the Master Plan
  Year 2004 to 2010 (7 years)

PRIORITY

The implementation priority for each bridge was given in accordance with the technical urgency.

Priority 1 (Very Urgent)

- The Ayala Bridge; Strengthening
  Seriously damaged/corroded low chords and floor system.
- Jones Bridge; Major-Scale Rehabilitation
  Ruptured and large lateral deformation of main girders.
- Guadalupe Bridge; Medium-Scale Rehabilitation
  Heavy cracks at girder hinge and abnormal vibration in the suspended span.

Priority 2 (Urgent)

- Quezon Bridge; Medium Scale Rehabilitation
  Heavily corroded gusset plates, bracing and ties of floor system.
- Lambingan Bridge; Medium-Scale Rehabilitation
  Medium cracks at girder hinge and uplift at end support of girder.
- Vargas Bridge; Large-Scale Rehabilitation
  Medium cracks at girder hinge and large deflection of girder which require large-scale rehabilitation, but not very urgent.

Priority 3 (Traffic Capacity Improvement)

- Second Ayala Bridge; New Construction
  Improvement of traffic capacity and flow at adjacent bridges such as the Ayala Bridge and Quezon Bridge, which is recommended to be implemented at economically optimum timing.

Implementation Schedule and Annual Requirement

Unit: million Pesos

			2004	2005	2006	2007	2008	2009	2010	SUB-TOTAL	TOTAL
Package I	Ayala Bridge	Detailed Design	20.5	20.4						40.9	1,256.9
		ROW Acquisition		63.0						63.0	
		Tender								-	
		Construction			535.7	535.6				1,071.3	
		Const. Supervision			40.9	40.8				81.7	
	Jones Bridge (ROW Acquisition not required)	Detailed Design	8.2							8.20	185.40
		Tender								-	
		Construction		54.70	109.4					164.10	
		Const. Supervision		4.37	8.73					13.10	
	Guadalupe Bridge (ROW Acquisition not required)	Detailed Design	1.0							1.0	23.10
		Tender								-	
		Construction		10.25	10.25					20.50	
		Const. Supervision		0.80	0.80					1.60	
	Sub-Total		**29.70**	**153.52**	**705.75**	**576.40**	-	-	-	**1,465.40**	
Package II	Quezon Bridge (ROW Acquisition not required)	Detailed Design		6.0						6.0	135.20
		Tender								-	
		Construction			39.97	79.73				119.60	
		Const. Supervision			3.20	6.40				9.60	
	Lambingan Bridge (ROW Acquisition not required)	Detailed Design			2.60					2.60	59.20
		Tender								-	
		Construction				52.4				52.4	
		Const. Supervision				4.20				4.20	
	Vargas Bridge (ROW Acquisition not required)	Detailed Design			1.3					1.30	29.50
		Tender								-	
		Construction				26.10				26.10	
		Const. Supervision				2.10				2.10	
	Sub-Total		-	**6.00**	**46.97**	**170.93**	-	-	-	**223.90**	
Package III	Second Ayala Bridge	Detailed Design				38.9				38.9	941.32
		ROW Acquisition				95.0	95.0			190.0	
		Tender								-	
		Construction						323.81	323.81	647.62	
		Const. Supervision						32.4	32.4	64.8	
	Sub-Total		-	-	-	**133.90**	**95.0**	**356.21**	**356.21**	**941.32**	
GRAND TOTAL			**29.7**	**159.52**	**752.75**	**881.23**	**95.0**	**356.21**	**356.21**	**2,630.62**	

26. CONCLUSION AND RECOMMENDATION

CONCLUSION

Justification of the Project

- The implementation of proposed improvement measures is justified based on the findings of the Study, to cope with the existing problems such as heavily deteriorated structures, limited traffic capacity and vessel collisions.
- The improvement of existing bridge as life line transport facilities is expected to promote the socio-economic activities in Metro Manila.

Viability of the Project

The proposed improvement measures were evaluated from various aspects of view and concluded to be feasible as follows.

- Technical Aspects
  All bridge improvement works require the sophisticated and state-of-the-art technology, especially, for the Ayala Bridge and Quezon Bridge.

- Economic and Financial Aspects
  Sufficient economic return is expected for each improvement project and the Second Ayala Bridge construction project as proven by the economic evaluation, which suggests the early implementation of the project.

- Environmental Impact Aspects
  From the characteristics of the improvement works of existing bridges, negative impact with the implementation are expected to be very minimal in terms of the social impact and the land acquisition aspects. Among the Study bridges, only the Ayala Bridge will affect 5 houses and 4 families, and Second Ayala Bridge 10 houses and 3 families. As for other bridges, there are no informal settlers will be affected.

RECOMMENDATION

Early Implementation

The proposed improvement project is in urgent need and recommended to be implemented at the earliest possible time, with the thorough preparation of the followings:

- Securing Environmental Compliance Certificate (ECC)
- R.O.W. Acquisition
- Preparation of Resettlement Plan for Project-affected People
- Fund Preparation

Temporary Implementation of Vehicle Load Limit Regulation for the Ayala Bridge

In case of delay in implementation, the vehicle load limit regulation shall be temporary implemented in order to secure the safety of the bridge users.

Monitoring the Bridges Requiring the Very Urgent Improvement Works

Its is strongly recommended for the following bridges that the progress of damages or deformation should be monitored and take necessary countermeasures if the progress of damages is found;

- Ayala Bridge : in addition to adopting certain load limit, abnormal deflection or vibration during vehicles' passing
- Jones Bridge : the progress of cracks of steel members and new evidence of vessel collisions
- Guadalupe Bridge : the progress of cracks width at gerber hinge parts

Implementation of Second Ayala Bridge

- Development control within road R.O.W. along the proposed route of the bridge
- A study on future extension of the Route

Dissemination of Established Technology as Sustainable Human Capacity Building Program

The highly developed engineering technique on assessment of structural soundness of existing bridges, damage diagnosis, load-rating analysis, etc., was established and compiled in the Manual under the Feasibility Study.

It is highly recommended that the dissemination of such technology shall be pursued as a program of sustainable human capacity building.

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