JAPAN INTERNATIONAL COOPERATION AGENCY

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

THE STUDY ON THE IMPROVEMENT OF EXISTING BRIDGES ALONG PASIG RIVER AND MARIKINA RIVER IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT MAIN TEXT (2/3)

JULY 2004

KATAHIRA & ENGINEERS INTERNATIONAL

CTI ENGINEERING INTERNATIONAL CO. LTD.

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on the Improvement of Existing Bridges along Pasig River and Marikina River in the Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a study team headed by Mr. Tsuneo Bekki of Katahira & Engineers International, and consisting of Katahira & Engineers International CTI Engineering International Co. LTD., to the Republic of the Philippines, five times between October 2002 and June 2004.

The team held discussions with the officials concerned in the Government of the Republic of the Philippines, and conducted field surveys on eighteen bridges (seventeen bridges : existing bridges, one bridge : a new bridge) . Upon returning to Japan, the team prepared this report.

I hope that this report will contribute to the improvement of the bridges in the Republic of the Philippines and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government and those concerned in the Republic of the Philippines for the close cooperation they extended to the study.

July 2004

Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency

Mr. Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency
Tokyo, Japan

July 2004

Dear Mr. Matsuoka,

Letter of Transmittal

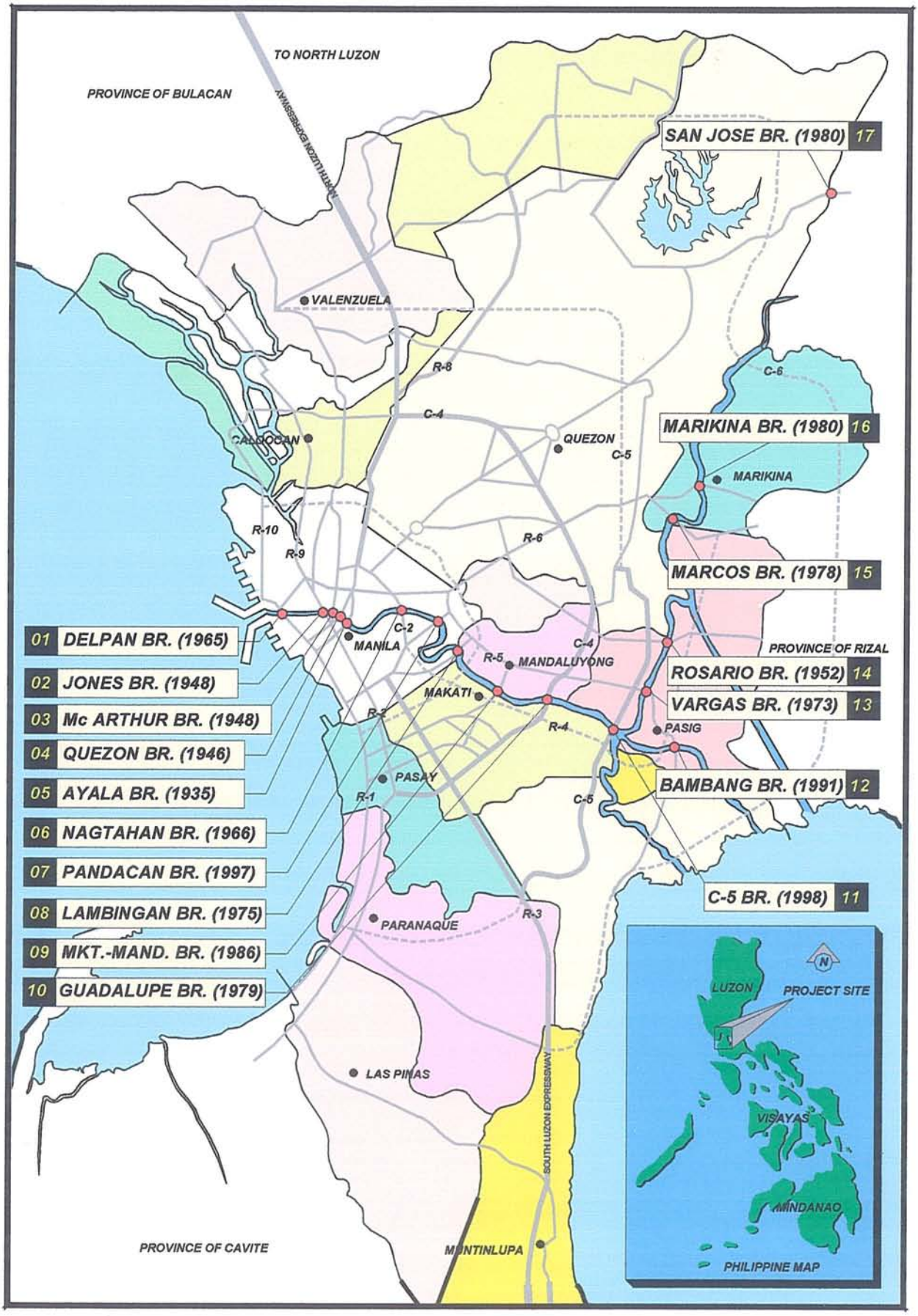
We are pleased to submit to you the report of "The Study on the Improvement of Existing Bridges along Pasig River and Marikina River in the Republic of the Philippines". The report includes the advises and suggestions of the authorities concerned of the Government of Japan and your agency as well as the comments made by the Department of Public Works and Highways and other authorities concerned in the Republic of the Philippines.

This report studies and analyses the condition of seriously and heavily damaged and deteriorated existing seventeen (17) bridges along Pasig River and Marikina River and presents the improvement works of these bridges. The report also studies the construction of new bridge in line with improvement of traffic function of Ayala Bridge. Moreover, this report proposed the urgent improvement works of seven (7) bridges (existing six (6) bridges and new construction of one (1) bridge) to be implemented in the period 2004 – 2010. The Study concludes that these projects are technically, economically, financially and environmentally viable and will contribute the socio-economic development in Metro Manila. In view of the urgency of improving bridges in Metro Manila, we recommend the Government of the Philippines to implement the projects with top priority.

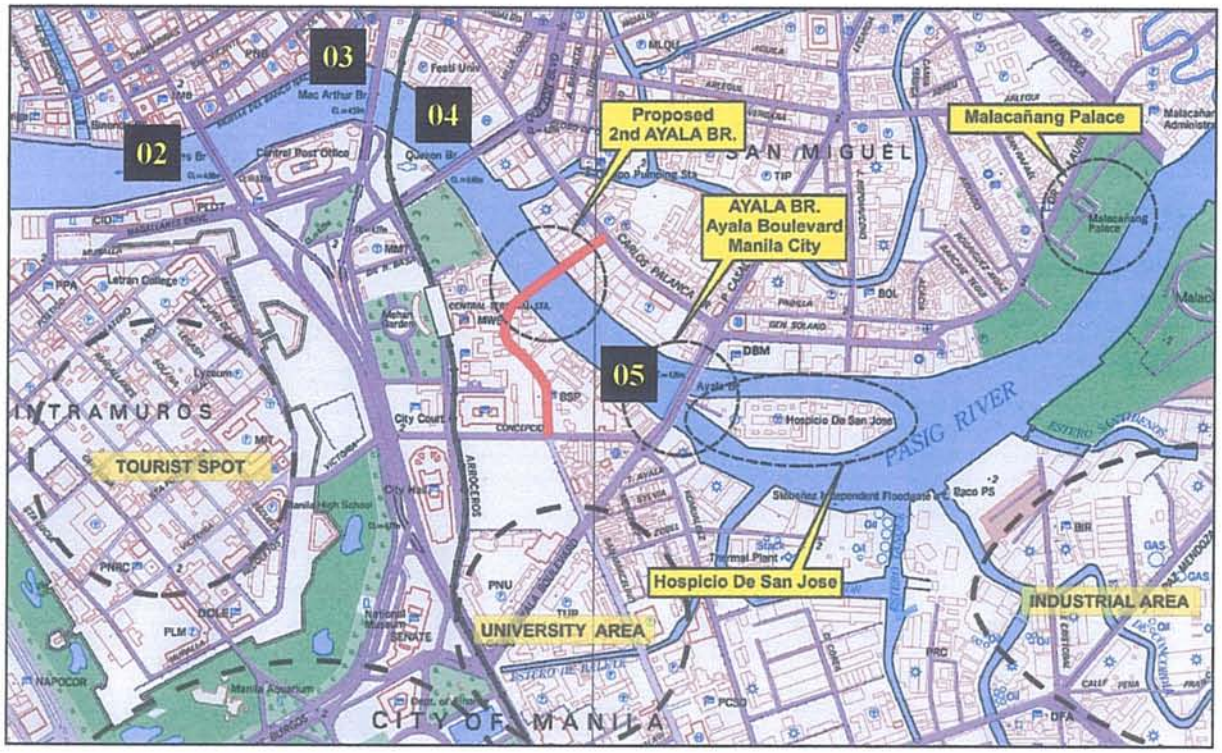
We wish to take this opportunity to express our sincere gratitude to your agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport. We also wish to express our deep gratitude to the Governmental Agencies concerned in the Republic of the Philippines for the close cooperation and assistance extended to us during the Study. We hope this report will contribute to the development of Metro Manila.

Very truly yours,

Mr. Tsuneo BEKKI
Team Leader
of the Study on the Improvement of Existing Bridges
along Pasig River and Marikina River
in the Republic of the Philippines



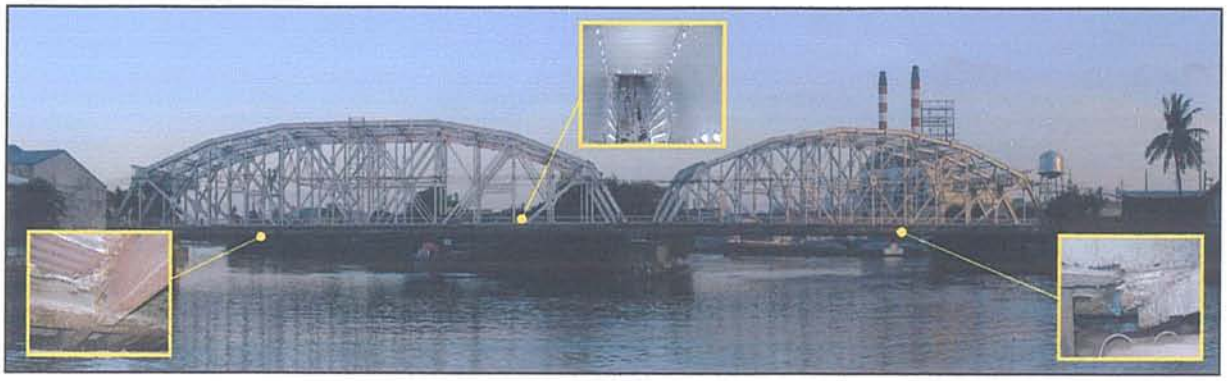
LOCATION MAP OF THE PROJECT



VICINITY OF PROPOSED SECOND AYALA BRIDGE

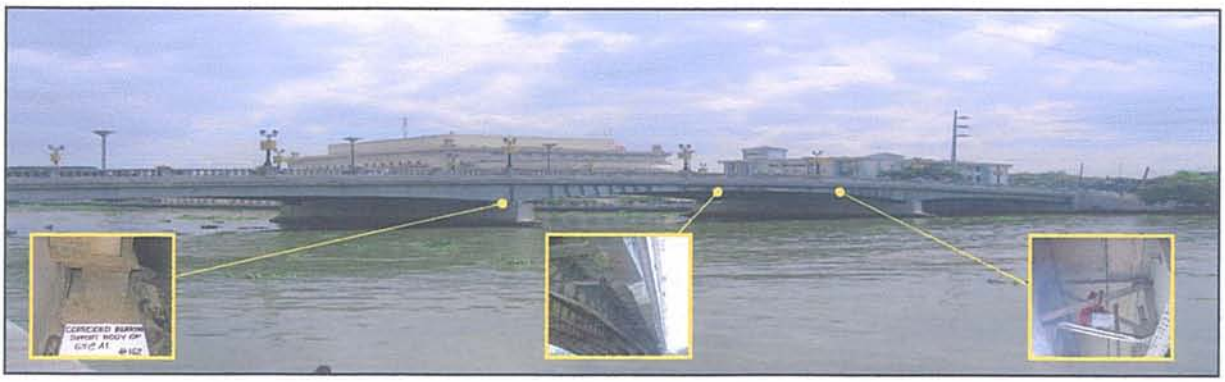
02 – JONES BRIDGE (1948)
03 – Mc ARTHUR BRIDGE (1948)
04 – QUEZON BRIDGE (1946)
05 – AYALA BRIDGE (1935)

PHOTOGRAPH OF MAIN BRIDGES

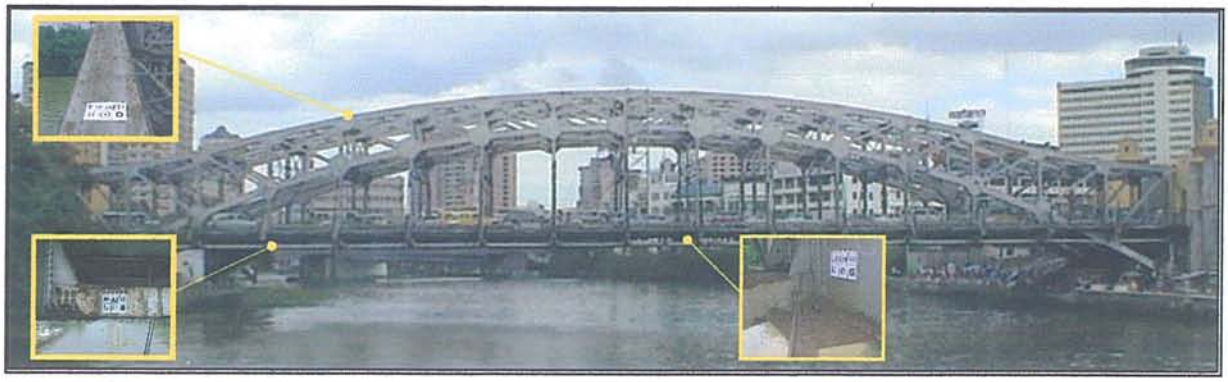


Ayala Bridge

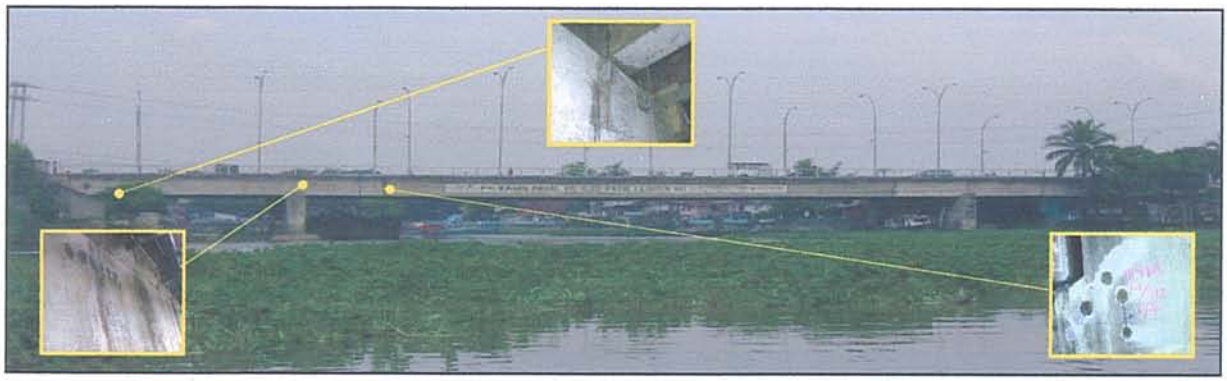
Proposed Second Ayala Bridge



Jones Bridge



Quezon Bridge



Lambingan Bridge

Guadalupe Quezon

Vargas Bridge

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ABBREVIATIONS

AADT	: Average Annual Daily Traffic
AASHTO	: American Association of State Highway and Transportation Officials
ADB	: Asian Development Bank
ADT	: Average Daily Traffic
AIP	: Annual Infrastructure Program
AMSL	: Above Mean Sea Level
APL	: Adaptable Program Loan
AS	: Allowable Stress
ASD	: Allowable Stress Design
BCA	: Benefit / Cost Analysis
BCGS	: Bureau of Coast and Geodetic Survey
BMS	: Bridge Management System
BOC	: Bureau of Construction
BOD	: Bureau of Design
BOE	: Bureau of Equipment
BOM	: Bureau of Maintenance
BORS	: Bureau of Research and Standards
BOT	: Built, Operation and Transfer
BPH	: Bureau of Public Highways
BRP	: Bridge Retrofit Project
BRS	: Bureau of Research and Standard
BSP	: Boy Scout of the Philippines
BSWM	: Bureau of Soils and Water Management
CGS	: Coast Guard Station
COD	: Chemical Oxygen Demand
COE	: Certificate of Exemption
CLUP	: Comprehensive Lands Use Plan
CPDO	: City Planning and Development Office
Danida	: Danish International Development Assistance

DAO : Department Administrative Order

DBM : Department of Budget and Management

DENR : Department of Environment and Natural Resources

DEO : District Engineering Office

DIA : Direct Impact Area

DO : Department Order

DO : Dissolved Oxygen

DOTC : Department of Transportation and Communications

DPH : Department of Public Highways

DPWH : Department of Public Works and Highways

DPWTC : Department of Public Works, Transportation and Communications

ECA : Environmental Critical Area

ECC : Environmental Compliance Certificate

EIA : Environmental Impact Assessment

EIAPO : Environmental Impact Assessment Project Office

EIRR : Economic Internal Rate of Return

EIS : Environmental Impact Statement

EMB : Environmental Management Bureau

EMK : Equivalent Maintenance Kilometer

EO : Executive Order

EUAC : Equivalent Uniform Annual Cost

EVF : East Valley Fault

FCA : First Cost Analysis

FTI : Flood Terminal Incorporated

FYBCR : First Year Benefit Cost Ratio

GAA : General Appropriate Act

GMA : Greater Manila Area

GNP : Gross National Product

GOJ : Government of Japan

GOP : Government of the Philippines

GRDP	: Gross Regional Domestic Product
HDSJ	: Hospicio de San Jose
HPD	: Historical and Preservation Division
HTL	: Highest Tide Level
IBRD	: International Bank for Reconstruction And Department
ICC	: Investment Coordinating Committee
ID	: Inspectorate Division
IEE	: Initial Environmental Examination
IIA	: Indirect Impact Area
IRR	: Implementing Rules and Regulations
ISD	: Inventory Statistics Division
JBIC	: Japan Bank for International Corporation
JICA	: Japan International Cooperation Agency
JRA	: Japan Road Association
LBCR	: Laguna de Bay Coastal Road
LCA	: Lifecycle Analysis
LF	: Load Factor
LFD	: Load Factor Design
LGUs	: Local Government Units
LOS	: Level of Service
LR	: Load Rating
LRF	: Load and Resistance Factor
LRFD	: Load Resistance Factor Design
LTFRB	: Land Transportation Franchising and Regulatory Board
LTO	: Land Transportation Office
LTPBMC	: Long Term Performance Based Maintenance Contract
MARINA	: Maritime Industry Authority
MBA	: Maintenance By Administration
MBC	: Maintenance By Contract
MBE	: Manila Bay Expressway

MCGS : Marikina Central Gate Structure

MCTE : Manila-Cavite Toll Expressway

MGB : Mines and Geosciences Bureau

MHHW : Mean Higher High Water

MMDA : Metro Manila Development Authority

MMD : Monitoring and Method Division

MMETROPLAN: Metro Manila Transport, Land Use and Development Planning Project

MMUEN : Metro Manila Urban Expressway Network

MMUESS : Metro Manila Urban Expressway System Study

MMUSTRAP : Metro Manila Urban Transportation Strategy Planning Project

MMUTDP : Metro Manila Urban Transportation Development Plan

MMUTIP : Metro Manila Urban Transportation Improvement Project

MMUTIS : Metro Manila Urban Transportation Integration Study

MMUTPS : Metro Manila Urban Transportation Planning Study

MNT : Manila North Tollway

MOOE : Maintenance, Operations and Other Expenses

MPH : Ministry of Public Highways

MPW : Ministry of Public Works

MPWH : Ministry of Public Works and Highways

MRT : Metro Rail Transit

MSHW : Mean Springs High Water Level

MSL : Mean Sea Level

MTC : Ministry of Transportation and Communication

MTDP : Medium-Term Transportation Development Plan

MTPDP : Medium-Term Philippine Development Plan

MVFS : Marikina Valley Fault System

MVUC : Motors Vehicle Users Charge

NAIA : Ninoy Aquino International Airport

NAPOCOR : National Power Corporation

NEDA : National Economic Development Authority

NEPC : National Environmental Protection Council

NG : National Government

NHA : National Housing Authority

NHI : National Historical Institute

NLE : North Luzon Expressway

NLEE : North Luzon Expressway East

NPV : Net Present Value

NRIMP : National Roads Improvement and Management Program

NSCB : National Statistical Coordination Board

NSCP : National Structural Code of the Philippines

NSO : National Statistics Office

NCR : National Capital Region

NHI : National Historical Institute

OD : Origin Destination

OSG : Office of Solicitor General

PAF : Project Affected Families

PAGASA : Philippine Atmospheric Geophysical Astronomical Services Administration

PAP : Project Affected Person

PAR : Philippine Area of Responsibility

PCB : Polychlorinated Biphenyls

PCG : Philippine Coast Guard

PCU : Passenger Car Unit

PHIVOLCS : Philippine Institute of Volcanology and Seismology

PHMMS : Philippine Highway Maintenance Management System

PIAM : Participatory Impact Assessment Method

PIP : Public Investment Program

PLDT : Philippine Long Distance Telephone Company

PMO : Project Management Office

PMP : Preventive Maintenance Program

PNCC : Philippine National Construction Corp.

PPA	: Philippine Ports Authority
PPD	: Planning and Programming Division
PPP	: Public-Private Partnership
PPP	: Piso Para sa Pasig
PRDP	: Pasig River Development Program
PRRC	: Pasig River Rehabilitation Commission
PRRP	: the Pasig River Rehabilitation Program
PS	: Planning Service
PSCG	: Pre-stressed Concrete Girder
PSG	: Presidential Security Group
PTFRPR	: Presidential Task Force on the Rehabilitation of the Pasig River
PTM	: Philippine Transverse Mercator
PUB	: Public Utility Bus
PUJ	: Public Utility Jeep
PW	: Present Worth
PWA	: the Public Works Act
QA	: Quarterly
RA	: Republic Act
RBIA	: Road and Bridge Information Applications
RDC	: Regional Development Council
RF	: Rating Factor
RHT	: Recorded Highest Tide
RIS	: Road Information System
RMS	: Root-Mean-Square
RO	: Regional Office
ROW	: Right-of-Way
RRS	: River Rehabilitation Secretariat
SAPROF	: Special Assistance for Project Formation
SLE	: South Luzon Expressway
STTC	: Saving Travel Time Cost

SVOC	: Saving Vehicle Operating Cost
TCM	: Traffic Capacity Manual
TD	: Tropical Depression
TSC	: Transportation Systems Center
TSP	: Total Suspended Particulate
TSS	: Total Suspended Soil
TT	: Tropical Typhoon
TTC	: Travel Time Cost
TWG	: Technical Working Group
UFG	: Ultrasonic Flaw Detection Test
UP-NCTS	: National Center for Transportation Study
UPV	: Ultrasonic Pulse Velocity
URPO	: Urban Road Projects Office
UTG	: Ultrasonic Thickness Gauging
UTSMMA	: Urban Transport Study in the Manila Metropolitan Area
VFC	: Vehicle Fixed Cost
VOC	: Vehicle Operating Cost
WDDT	: Daily Traffic Volume at Weekday
WEDT	: Daily Traffic Volume at Weekend
WVF	: West Valley Fault

PART III

FEASIBILITY STUDY OF
AYALA BRIDGE IMPROVEMENT PLAN

CHAPTER 13

DETAILED BRIDGE SURVEY AND ASSESSMENT

CHAPTER 13

DETAILED BRIDGE SURVEY AND ASSESSMENT

13.1 REVIEW OF DESIGN AND REPAIR WORKS

The detailed bridge survey and assessment is discussed in line with the flow chart shown in **Figure 13.1-1**. This survey level corresponds to the "Feasibility Study Level" as defined in the Manual prepared by the Study Team.

13.1.1 Review of Design

(1) Outline of Ayala Bridge

The following information are contained in the Design Notes of the Ayala Bridge As-Built drawings obtained by the Study Team:

- The east and middle trusses of the north span were constructed in 1935,
- The west truss of the north span was constructed in 1950,
- Three trusses of the south span were constructed in 1950,
- The east and middle trusses of the south span were replaced with the present two trusses,
- Two east trusses of the south span were originally constructed in the early 1900, but were reconstructed in 1950 due to bridge widening,
- The west parts of the abutment and the pier were added to the existing substructures in 1950.

(2) General Notes of Reconstruction of Ayala Bridge in 1950

- 1949 A.A.S.H.O. Standard Specifications For Highway Bridge
- Live Load MS18, Design Unit Stresses: fs = 124 MPa, fc = 6.9 MPa, n = 10.
- Philippine Government Standard Specifications for Highways and Bridges (August 1948) was adopted.

(a) Dimensions

Dimensions and elevations are based on the following sources of information:

- 1935 Bureau of Public Works Plan for the Original Bridge Addition.
- 1947 Plan of Bridge Site Survey by the Office of the City Engineer Manila
- 1948 Bureau of Public Works Plan for Bailey Addition; site of the west roadway.

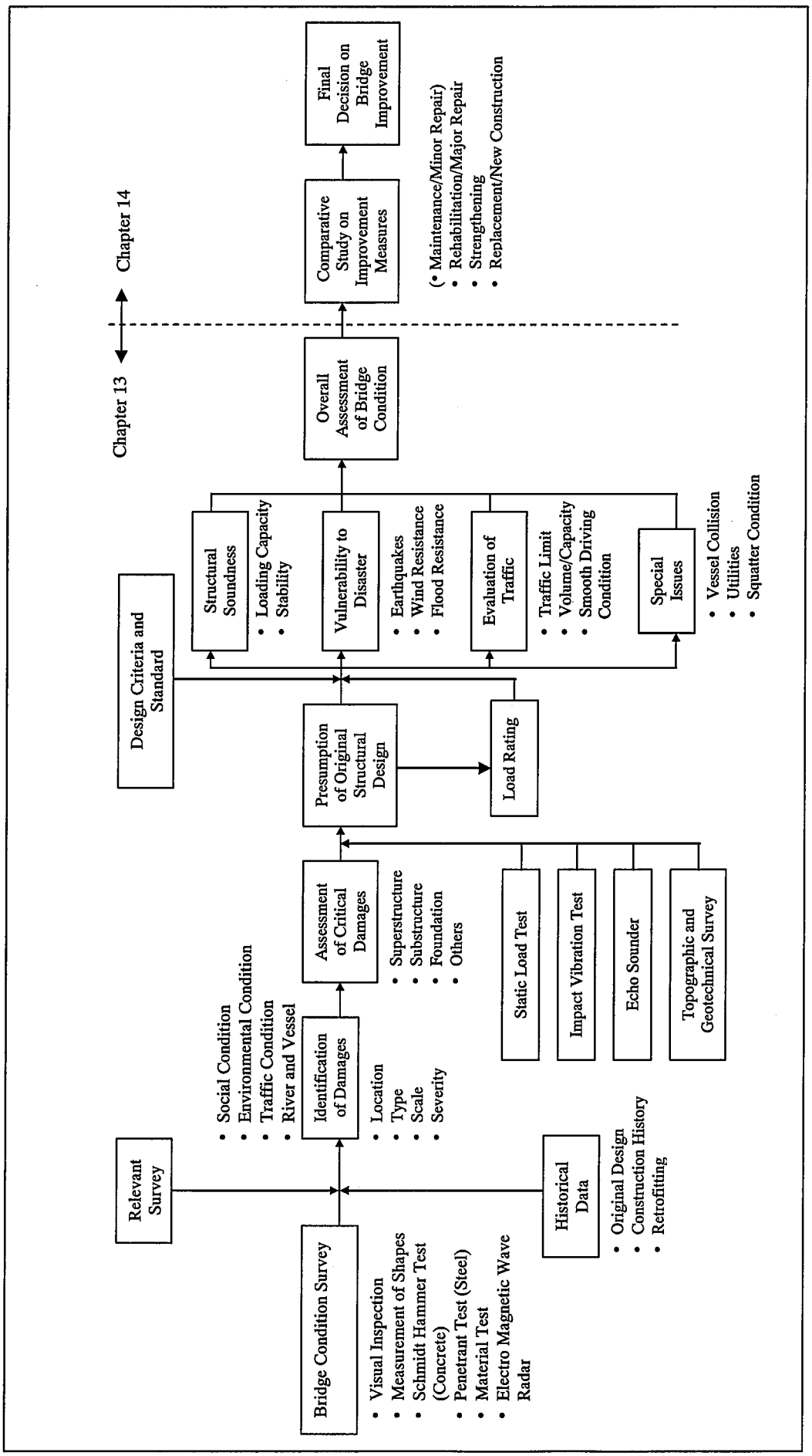

Figure 13.1-1 Flow Chart of Detailed Bridge Survey and Assessment

- 1945 U.S. Army Plan for Pony Trusses (At the site of the east roadway, south span)
- 1949 Joint Details and Camber Information Supplied by the Office of the City Engineer on the Basis of field measurement.
- 1949 U.S. Bureau of Public Road field measurements.

(b) Construction Materials

Concrete

Concrete used is Class "A" concrete with fc = 6.9 MPa.

Reinforcing Steel

Reinforcing steel bars used has allowable stress, fs = 124 MPa.

Structural Steel

Structural Steel with allowable stress of fs = 248MPa was used with ø22mm rivets.

13.1.2 Review of Rehabilitation Works

Figure 13.1.2-1 shows a comparison of the bridge condition before and after the rehabilitation works done using local funds for the Ayala Bridge in 2002.

(a) Outline of the Works

Rehabilitation of Lower Chords

After surface preparation with wire brushes, the lower chords were strengthened by welding steel plates and angle bars, as shown in **Figure 13.1.2-2** (a) and (b).

Joint Area of Lower Chords

Joint area of lower chords were strengthened by fillet welding of steel plates onto existing gusset plates as shown in **Figure 13.1.2-2** (c).

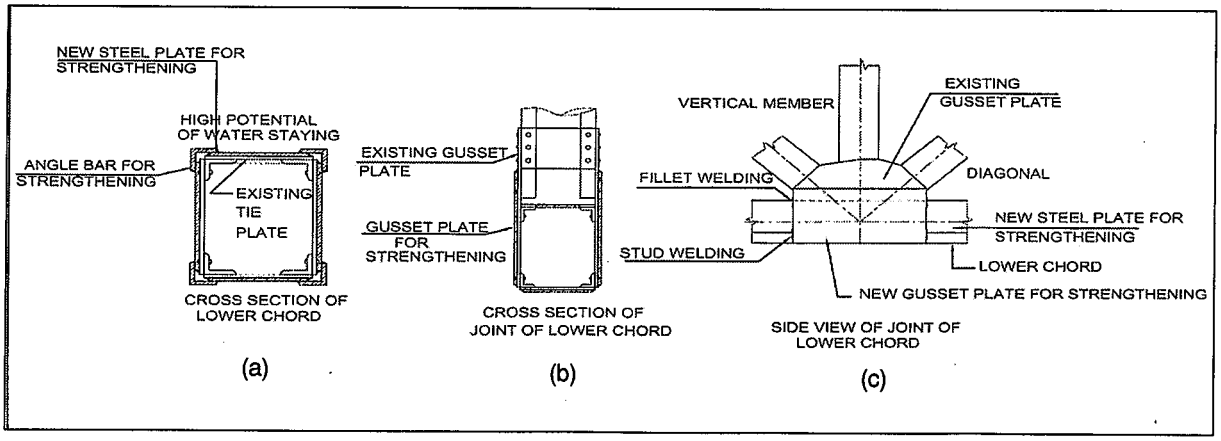

Figure 13.1.2-2 Rehabilitation of Lower Chords

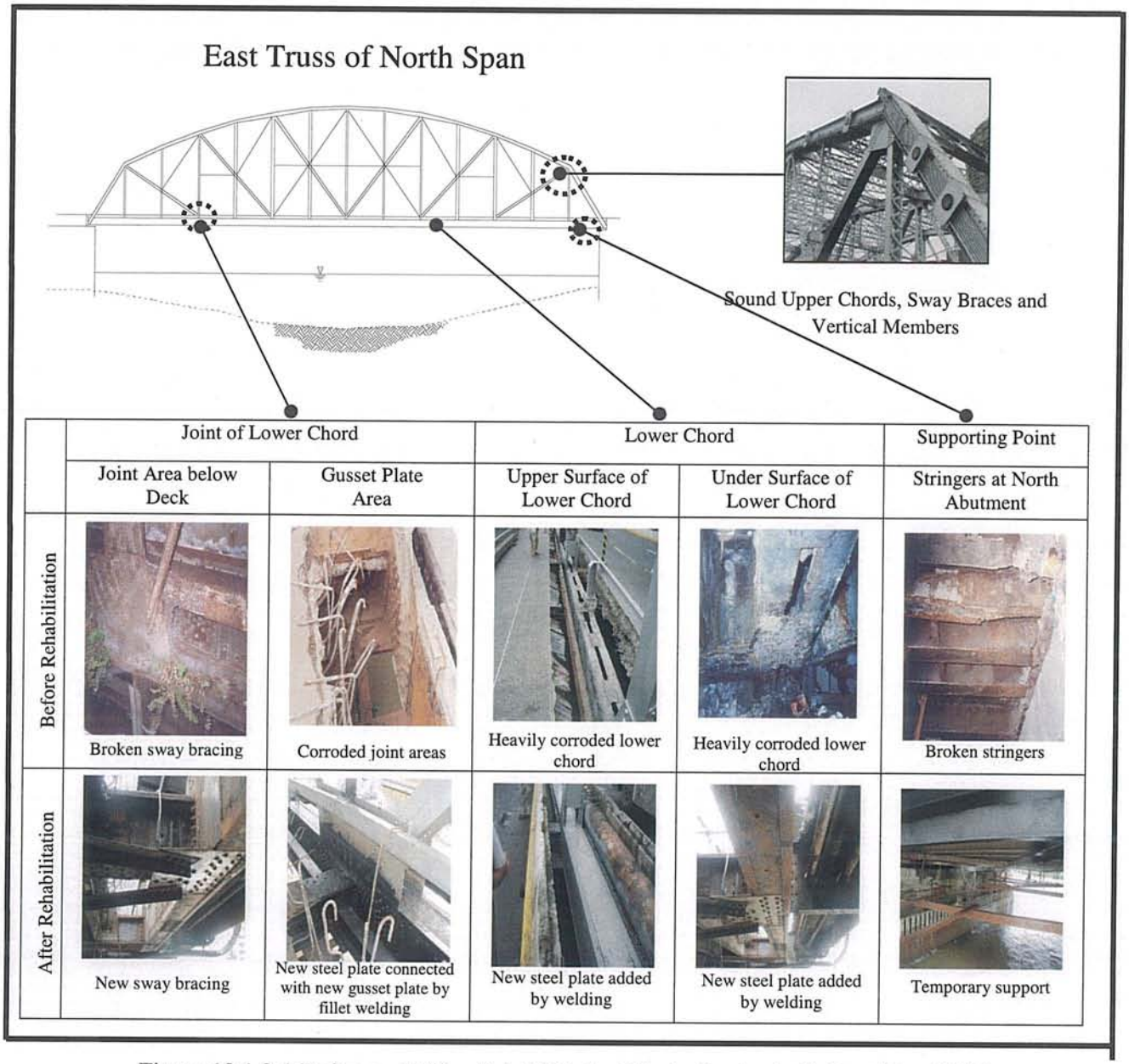

Figure 13.1.2-1 Before and After Rehabilitation Works for Ayala Bridge (Year 2002)

Floor System

The ends of stringers were heavily corroded and partially broken. Under the rehabilitation works, broken stringers on the upstream side of the north span were supported by a temporary structure support, as shown in **Figure 13.1.2-1**.

(b) Problems/Issues of Past Rehabilitation

An In-Depth Survey was recommended for the Ayala Bridge considering the conditions below following the rehabilitation works.

- The fillet welding of steel plates for strengthening onto existing gusset plates is considered to be insufficient in terms of the increase of structural capacity. Prime members should be connected (butt welded) with each other.

- Stud welding between steel plates strengthening for lower chords and gusset plates is considered to be insufficient for strong tension forces. New gusset plates should overlap with adequate length with new steel plates for strengthening.

- The level of present rehabilitation is considered to be a temporary emergency countermeasure because broken stringers are just supported by only a temporary structure.

- The inner faces of lower chords have high potential for corrosion because they are not closed completely. This will accelerate corrosion of the inner steel plate.

- New steel plate added to existing one of the lower chords is connected by two angle bars on each side as shown in **Figure 13.1.2-2 (a).** Leaking water will easily stay because water flow is blocked by these angle bars. This will accelerate corrosion of the new steel plate.

13.1.3 Historical Background

In 1871, the construction of two bridges was recommended, to connect the two opposite banks of the Pasig River. The first bridge would connect the Arrabal of San Miguel with the Isla de Convalecencia, which is located at the center of the Pasig River. The second bridge would connect the Isla de Convalecencia with the Barrio of Concepcion.

The project began in 1872 and the Ayala Bridge was opened to the public in 1880. When completed, the bridge was called as the Puente de Convalecencia. However, several years later, it was commonly referred to as the Puentes de Ayala, after the famous industrial factory owned by the Ayala-Roxas family at the Arrabal of San Miguel to which the bridge led.

Figure 13.1.3-1 shows the Ayala Bridge constructed in 1876, which crossed the river in two independent sections that converged on Convalecencia Island. Three low arches and a lower platform, all of which were timber-built, formed each of these sections.

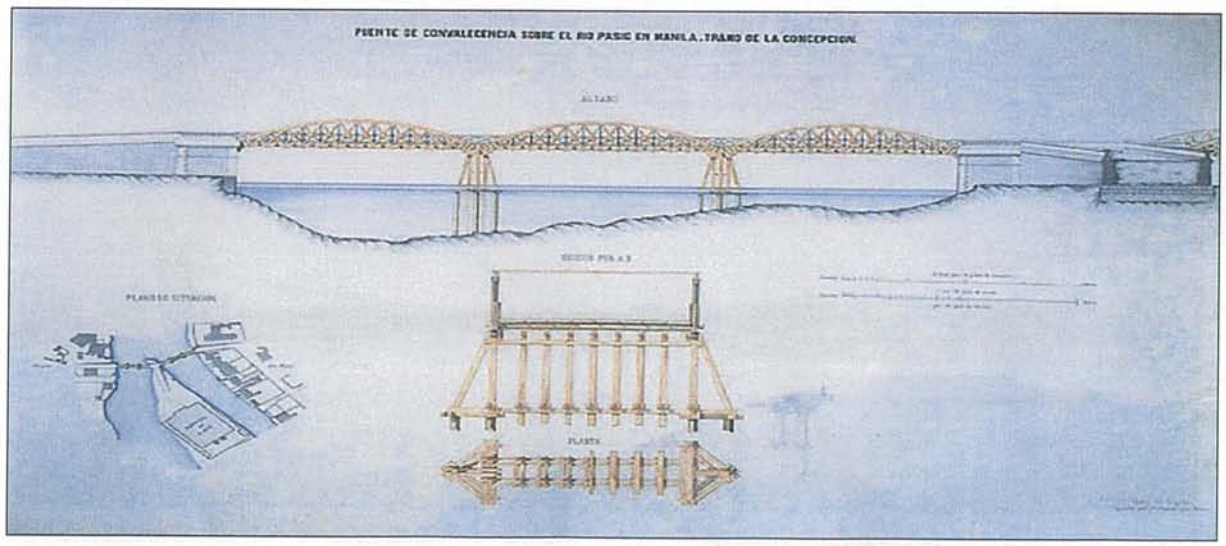

Figure 13.1.3-1 Ayala Bridge (South Span Side)

In 1882, repair works were made in the bridge, following which another re-assessment of the bridge was conducted for possible repairs to be executed as shown in **Figure 13.1.3-2.** Although scarcely ten years had passed since it was opened, by 1889 the Ayala Bridge was in a dangerous condition. The section between the island and the San Miguel district collapsed, and only a few months later the concepcion section followed suit.

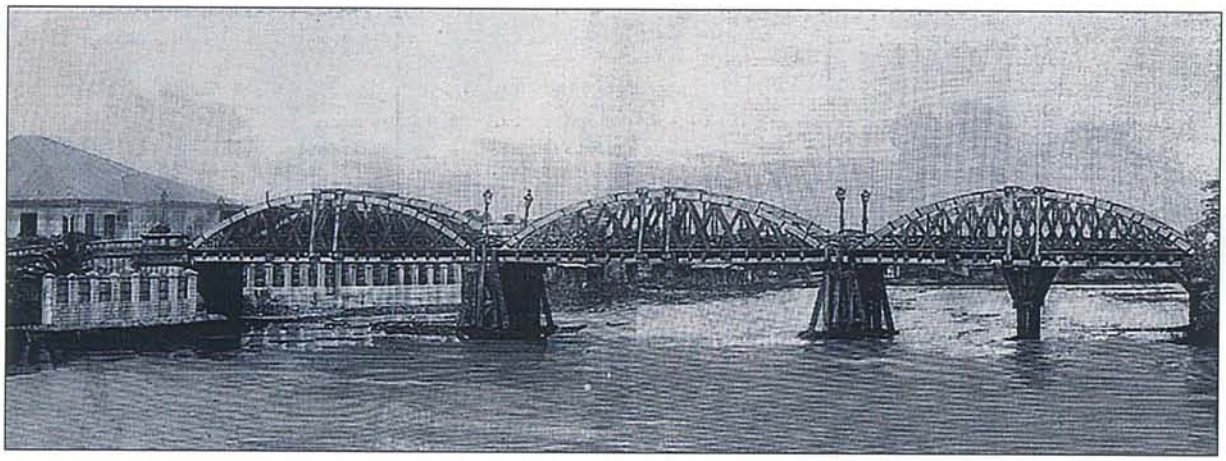

Figure 13.1.3-2 Ayala Bridge After Repair Works (Added Pier at the Center of Right Span) in 1890 (South Span Side)

During the early American period, a new proposal to replace the old bridge with a new steel superstructure was made. New construction started in March 1906. The bridge which originally was composed of two bridges, thus plural nomenclature of Puentes de Ayala, became one continuous riveted structure with pin bearings, made up of two spans of Pratt double type with a curved upper chord, having a clear roadway width of 6.70m and two sidewalks of 1.75m wide. The new bridge was opened to public traffic on August 13, 1906. This new bridge became the original shape of the present Ayala Bridge.

In 1950 after the Second War, the replacement and additional new bridge construction works were conducted. Through these major works the present Ayala Bridge was constructed and has maintained its original configuration like the curved upper chord since 1906, as shown **Figure 13.1.3-3**.

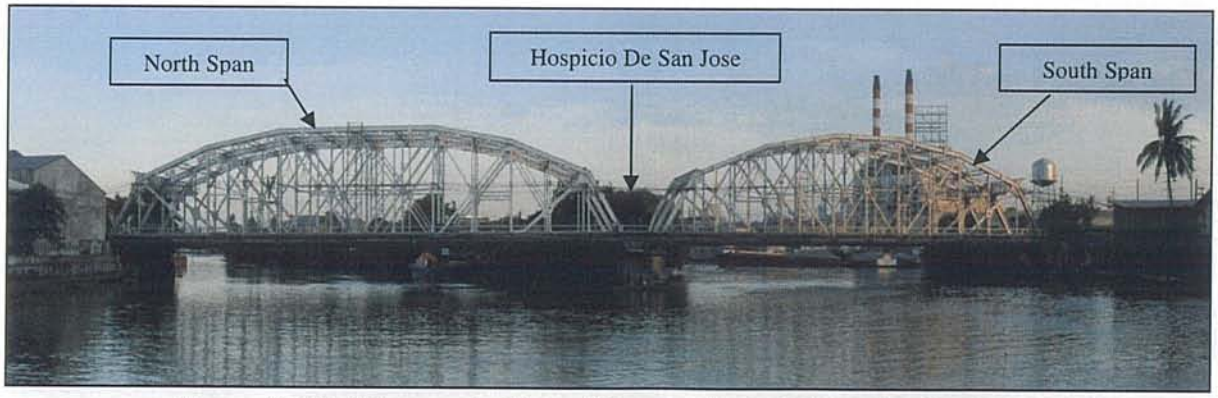

Figure 13.1.3-3 Panoramic View of Present Ayala Bridge (Looking East)

The National Historical Institute (NHI), which is one of government organizations endorsing the issuance of the ECC, has declared the Ayala Bridge as a historical legacy and landmark which should be preserved for posterity.

13.2 NATURAL CONDITION SURVEY

13.2.1 Topographic Survey

(1) Control Monuments

The control monument for the topographic survey is Station MMA-47, from Roxas Boulevard turning right to CCP Complex along Vicente Sotto Road. It is located in the center island of the said road between No. 2 and No. 3 round plant box about 25m from Roxas Blvd. fronting the Traders Hotel and North East side of CCP vicinity lawn. Station mark is the head of a 2 in. copper nail centered in cement putty with inscription "MM-47, 1995".

WGS84 Coordinates: N 14° 33' 28.92840" / E 120° 59' 13.27127" Ellipsoidal Ht: 48.6524 m

The established station was used as take-off points and a closed loop traverse was conducted within the project area as prescribed in the Manual for Land Surveys in the Philippines. The elevation was established using the three wire differential leveling method.

(2) Stationing

The longitudinal stationing was reckoned from the center of the pier, which is Sta. 0+169.049 based on the original plan. The following are the established control points:

Station	Northing	Easting	Elevation	Description
BM 1 = GPS 1	1,613,829.09	498,348.90	12.159	A concrete monument with concrete nail driven on top, located inside the Muslim compound, 20 m. away from a basketball court and 1 m. from a wall, 70 m. downstream of the 2nd bridge approach.
BM 2 = GPS 2	1,613,687.53	498,342.31	11.89	A concrete monument with concrete nail driven on top, located at the bank of Pasig River, 15 m. away from Ayala Bridge, left of the 1st approach.
BM 3	1,613,596.90	498,434.76	13.269	A concrete monument with concrete nail driven on top, located near a sari sari store beside the PLDT Compound, 100 m. right of the 1st approach.
BM 4	1,613,660.13	498,490.81	11.801	A concrete monument with concrete nail driven on top, located beside the canteen inside the Hospicio de San Jose compound. It is parallel to BM No. 3, 2 m. from a wall.
BM 5	1,613,730.19	498,515.07	12.106	A concrete monument with concrete nail driven on top, located inside Hospicio de San Jose, 3 m. from boundary wall, 110 m. from Ayala Bridge.
BM 6	1,613,782.35	498,522.40	12.022	Located on top of foothpath at the right side of Pasig River and is beside the DBM Building, 3 m. away from the boundary wall, 90m. from the bridge.

(3) Topographic Survey

Topographic survey was conducted using the established control points and through the use of a Total Station with an Electronic Field Book, sideshots were taken at all natural and man-made features. Also, sideshots were taken at ground points at suitable interval to come-up

with a terrain model reflecting the true topography of the site. The scope of work is listed in **Table 13.2.1-1** and the result is given in **Appendix 13.2.1-1.**

Table 13.2.1-1 Scope of Work

Description	Original Scope	Actual Work
Control Point Survey (GPS)	1	2
Profile Leveling	Bridge Section (150m), and 200 m. each of approach road on both sides of the bridge, TOTAL = 550m.	Bridge Section (150m), and 200 m. each of approach road on both sides of the bridge, TOTAL = 500m. Six (6) intersecting Roads, TOTAL = 755m.
Cross Sectioning	Bridge section (150 m): 10m interval Approach Road (400 m): 20m. interval Width: Bridge width 25m+50m. each on both sides (125 m.) TOTAL = 35 sections	Bridge section (150 m): 10m. interval Approach Road (400 m): 20m. interval Width: Bridge width 25m+50m. each on both sides (125 m.), TOTAL = 38 sections Bridge section showing the river cross section, TOTAL = 14 sections
Topographic Survey	500m length by 125m width, TOTAL = 6.9 ha.	580m length by 240m width, TOTAL = 9.8 ha. Topo (features) of Hospicio de San Jose, TOTAL = 3.5 ha.
River Cross-Section Survey	Both sides of bridge: 2 sections, upstream side: 2 sections, downstream side : 2 sections, TOTAL = 6 sections	Both sides and centerline of bridge: 3 sections, upstream side: 3 sections, downstream side: 3 sections, TOTAL = 9 sections 1.0m interval sounding at abutments and pier, TOTAL = 0.162 ha.

13.2.2 Geotechnical Survey

One borehole was drilled near the bridge pier, which was accessed through the Hospicio de San Jose.

The borehole was advanced from the ground surface down to the 44.83m by the wash boring and rotary drilling method. The drilling on the upper 12m of the soil revealed clayey to non-plastic sands that exhibited loose to medium dense soil conditions. SPT values appeared erratic with no noticeable increasing/decreasing trend. Beneath -12m is a 4m thick layer of clay that relate to soft to very stiff consistency. Below is a 1.0m lens of medium dense, non-plastic silt. Following this layer is a two-meter thick, very loose, silty sand layer with SPT values that are less than 5 blows per 305mm sampler penetration.

Comprising the remainder of the drilling depths are 12m thick, moderate to highly plastic clays that exhibited medium to hard consistencies. It was noted that the continuous refusal blow counts, relating to more than 50 blows stated at -40.78m. The materials nearest to the bottom of the drilling (below -41.69m and until -44.83m) are very dense sands with refusal blow counts. Subsurface conditions are presented in the form of soil profile and boring logs, these are shown in **Appendix 13.2.2-2.**

13.2.3 Scour Survey

An Echo Sounder (Hondex PS-7 LCD Digital Sounder) combined with Total Station was used for the determination of the riverbed configuration, with observations taken at every 1 meter intervals at the abutments and pier.

Preparation of the Plan

The processing of the topographic and hydrographic data was done using SDR Mapping and Design Software. The processing includes Feature Codes and contour generation.

The riverbed configuration covering 115 meters downstream and 115 meters upstream portion with an estimated area of 2.85 hectares has been determined through the use of a Hondex PS-7 LCD Digital Sounder for depth measurement and a Total Station for position/coordinate.

River cross-sections parallel along the bridges structure were taken at 15, 40, 65 and 115 meters upstream and downstream portion of the river and along the centerline of the bridge structure.

Sufficient side shots and observations were taken at closer interval around the location of the substructures in order to determine a more detailed riverbed configuration. The scour survey results are illustrated in **Figure 13.2.3-1.**

From these results, scouring around foundation was not observed.

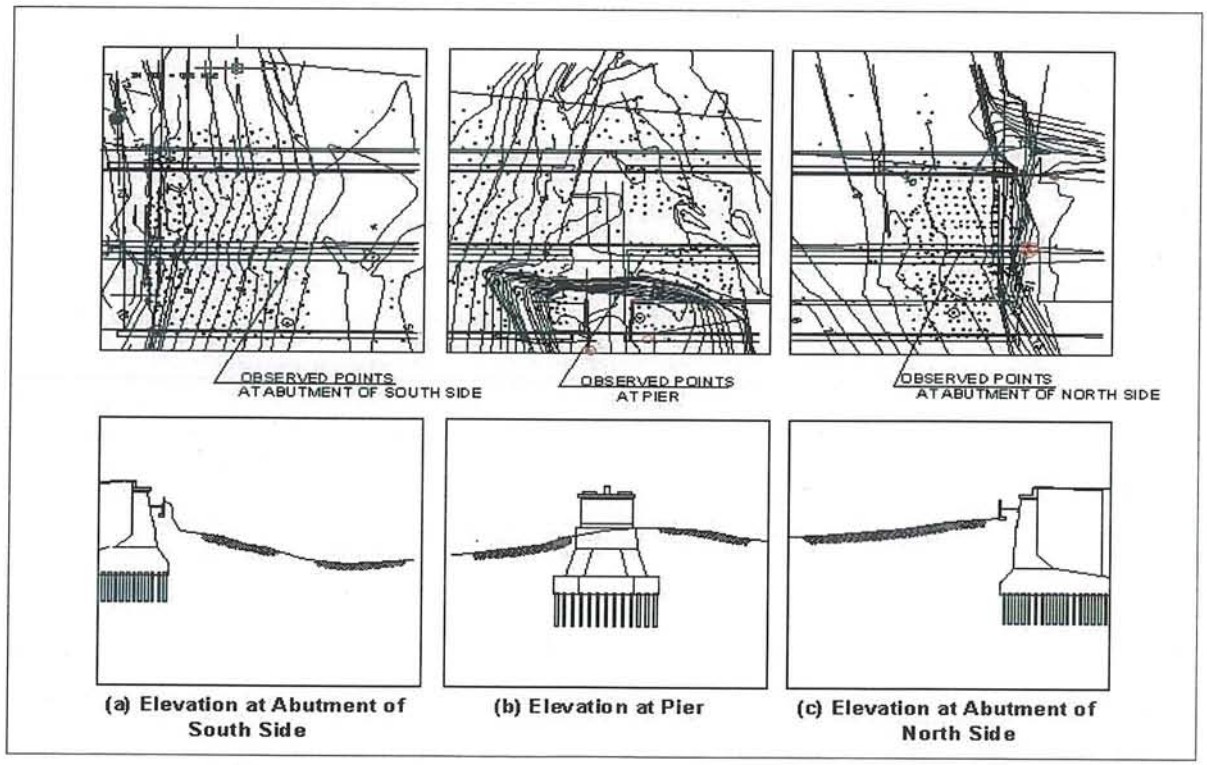

Figure 13.2.3-1 Results of Scour Survey at Abutment and Pier