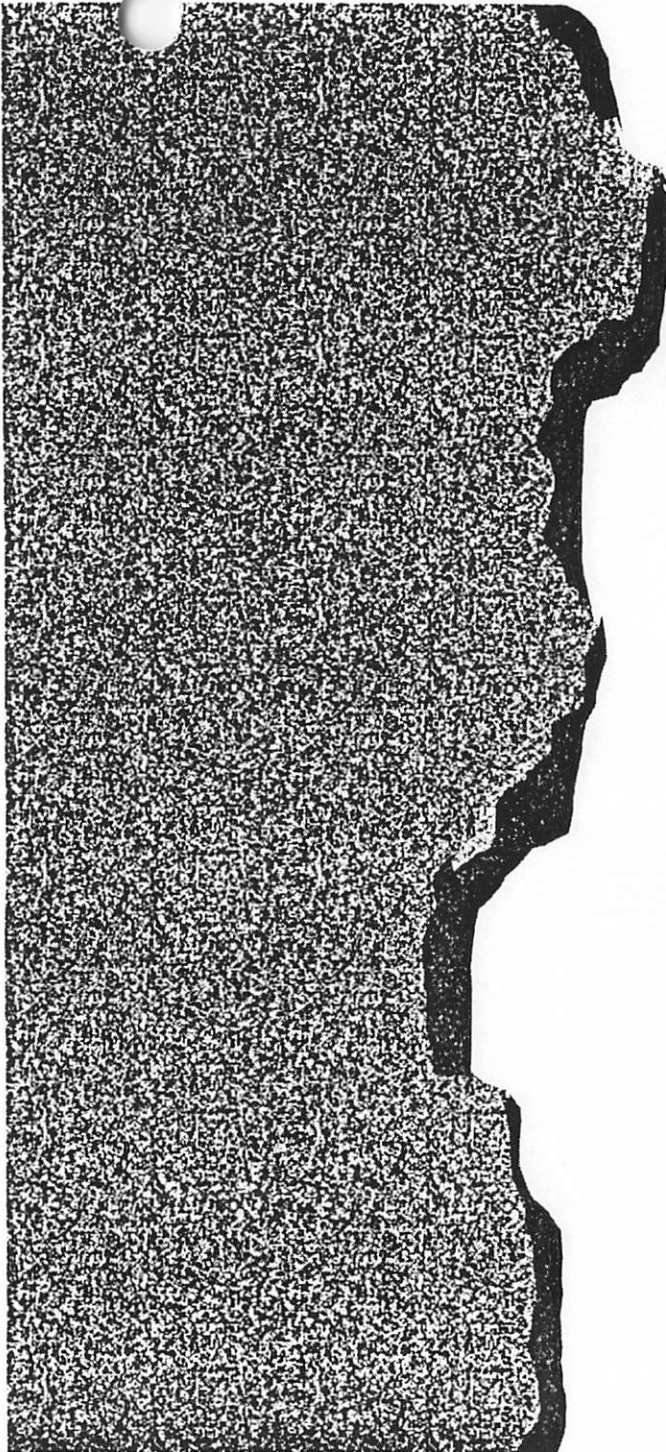




Moving Beyond Theory to Implementation

ICA-Miramar Metro San Juan
Alignment Section 1, Bayamón
January 13, 1996



ICA-miramar
Metro San Juan, Corp.



**UPR/MIT Tren Urbano Technology Transfer Program
Bayamón Alignment Section 1
January 13, 1997**

**Tren Urbano Alignment Section 1
Station Design**

**Axel Torres, Arq.
Station Design Architect
Taller Borinquen
ICA Miramar Metro San Juan**

Station Design

Introduction

The Tren Urbano is the largest infrastructure project in the history of Puerto Rico, a \$965 million dollar investment, which will lead the Commonwealth into the 21st century. Systematic development is the methodology of the Tren Urbano engineering design effort. The major development phases of station designs were prepared in a preferred and logical order:

1. Prototypical station designs and urban design guidelines
2. Design criteria and directive drawings
3. Standard drawings and specifications
4. Preliminary station designs
5. Contract Drawings

The individual stations will be designed with specific requirements including line location, patronage requirements, topographic and geological configurations, economy of function, and construction methods.

Urban Design

The station sites were designed to efficiently handle vehicular and pedestrian circulation flows, fit sensitively into their context, minimize their impacts on surrounding properties, good neighbor to adjacent communities and reflect the system's modern and efficient civic character.

The station site shall be designed as a safe and secure zone whose sole purpose is to serve the station. It shall be designed to discourage inappropriate behavior, such as loitering, vandalism, graffiti and poster application, illegal parking and other vehicular violation and crime.

The station site shall be clearly visible, easy to recognize, well-lit, and designed as a cohesive "defensible" station building.

Bayamón Centro Station

Patronage :

Daily boarding: approx. 22,975 patrons

AM Peak boardings : approx. 3,918 patrons

Station type :

Elevated center platform mid-block station

Station Access:

Walking: From Bayamón Centro town area, Barbosa pedestrian mall terminals, Virgilio Dávila public housing project, and Santa Cruz Street.

Drive : From North Bayamón area (Río Hondo, La Cambija, Sierra Bayamón, Estancia, Riverview, Quintas, Campo Verde); East (Riverside, Santa Cruz, Villa España, River Park, Juan Sánchez); West (Sierra Bayamón).

Transfer: AMA bus terminal & público terminal at Degetau Street, Guadarrama público terminal at Isabel II Street, Kuilán público terminal at PR-167.

Site Planning:

Públicos, buses, taxis and "kiss and ride" curb areas layout.

Station Design:

1. Elevated terminal mid-block
2. 100% platform covered canopy
3. 138 meters platform length
4. 8.50 meters wide platform
5. 2 entrances and 2 control points
6. Elevators in paid areas
7. 2 escalators
8. Stairs

Complejo Deportivo Station**Patronage:**

Daily boarding : approx. 4,614 patrons

AM Peak boardings : approx. 743 patrons

Station type:

Elevated side platforms station

Station access:

Walking : A small number walk-in patrons will originate from the Judicial Center, Virgilio Dávila housing project and Santa Rosa shopping mall.

Drive : Small patronage arrive from nearby residential areas, mostly "kiss and ride" and some "park and ride".

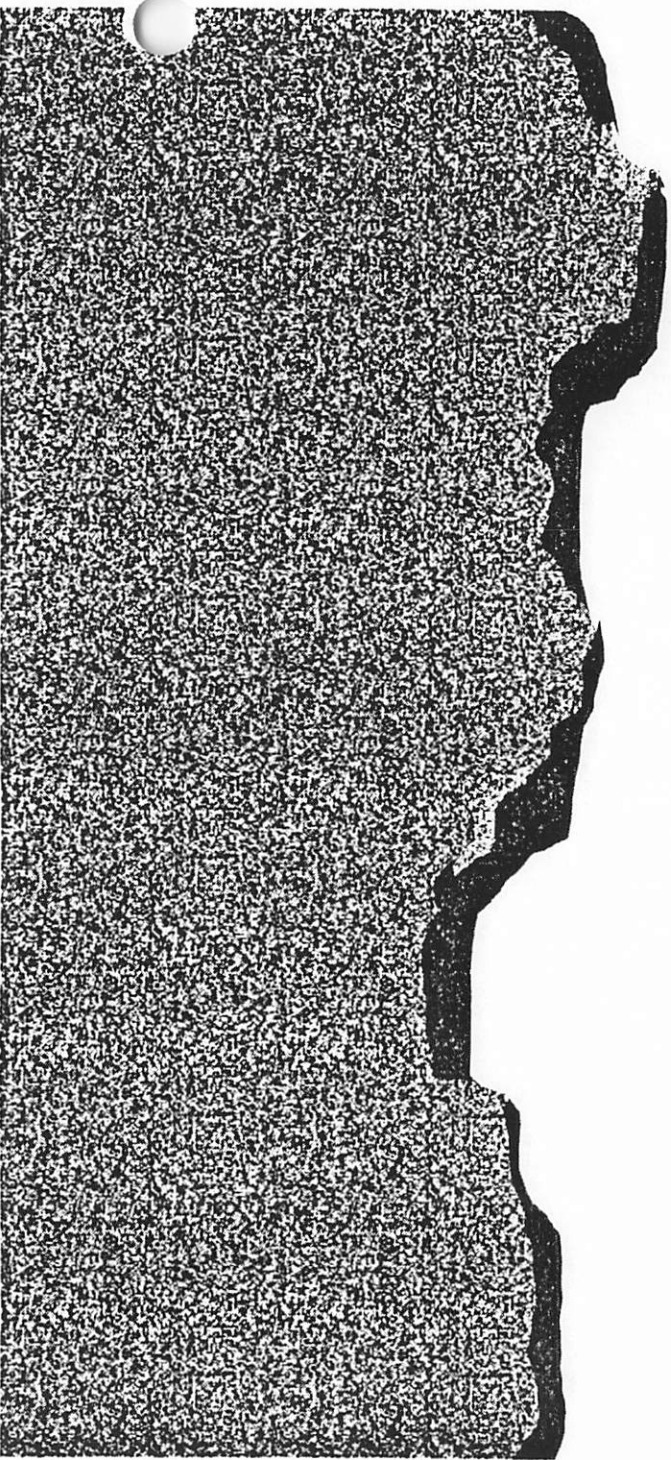
Transfer: Vast majority of transfer will arrive via públicos and AMA routes on PR-2, públicos and taxis from PR-174.

Site Planning:

Based on its ability to avoid impacts to Bayamón Central Park and to improve access to the Judicial Center and the Sports Complex, this alignment crosses over the PR-2/PR-174 intersection into the Sports Complex and passes between the Juan Ramón Loubriel Municipal Stadium and the Rubén Rodríguez Coliseum, with the station located over the parking facilities just south of the Bayamón Judicial Center..

Station Design:

1. Single entrance and one control point
2. 100% of platform covered canopy
3. Elevated mid-block
4. 2 side platforms
5. 138 meters platform length
6. 3.66 meter platforms
7. 2 elevators in paid areas
8. 3 escalators
9. Stairs



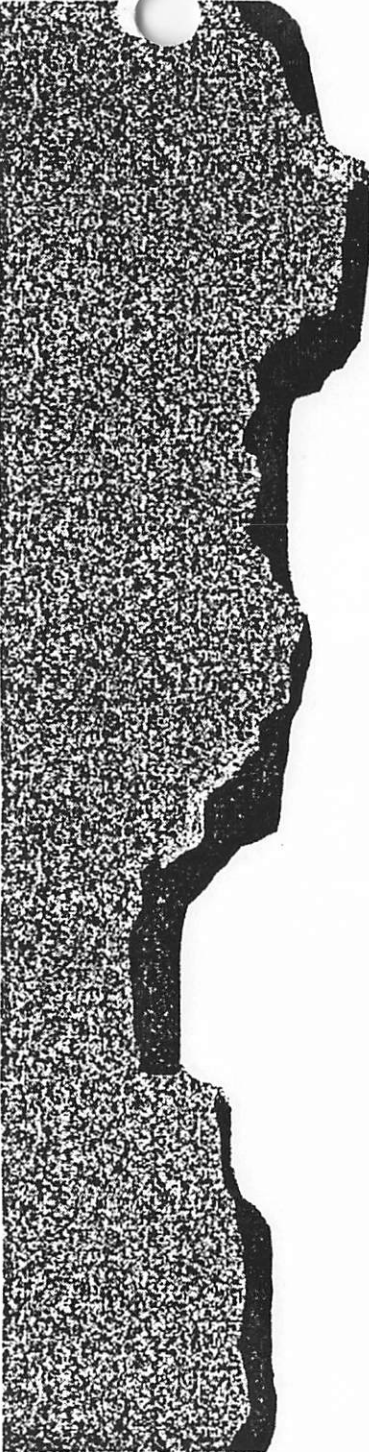
Quality Assurance and Quality Control

Joseph G. Borden
Quality Assurance Manager



ICA-miramar
Metro San Juan, Corp.





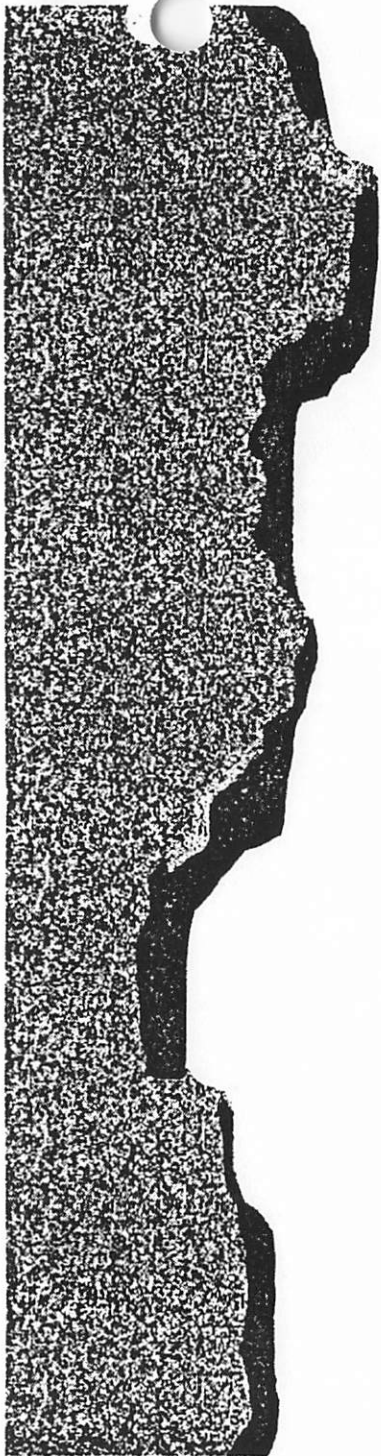
Project and Construction Management Guidelines

Project Management Plan

U.S. Department of Transportation

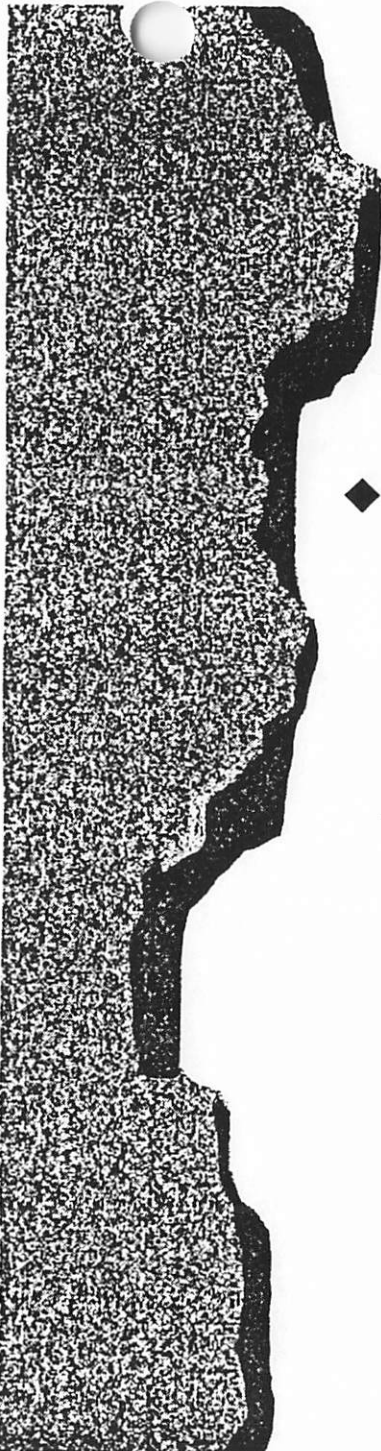
Federal Transit Administration

Office of Technical Assistance and Safety



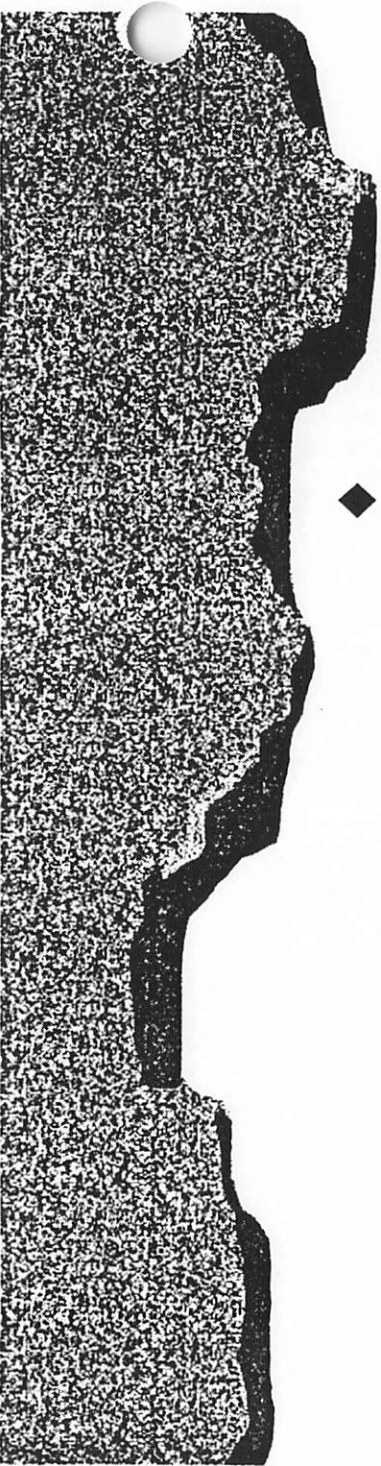
Quality Assurance Program Requirements

- ◆ **Organization**
- ◆ **Technical Requirements**
 - Contractor's QA Program
 - Owner's QA Audits
 - Contractor Surveillance
 - Testing
 - Configuration Requirements



(Cont.)

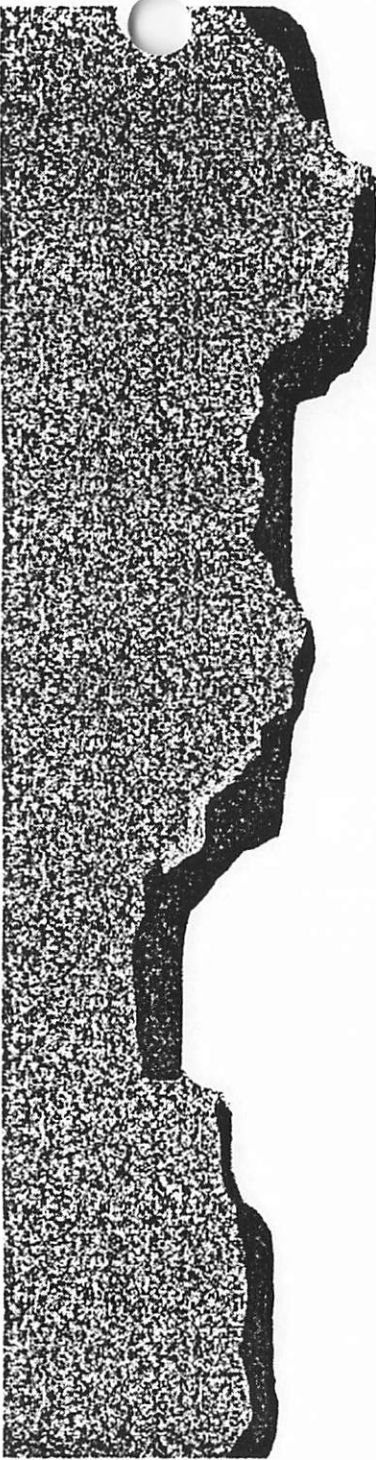
- ◆ **Program Management Requirements**
 - Owner's QA
 - Quality Control
 - System Wide Engineering
 - Owner's Program/Construction Management
 - Owner's Test Director
 - Owner's Operations Dept.



(Cont.)

◆ **Documentation**

- Contractor Documentation
- Owner's QA Program Documentation

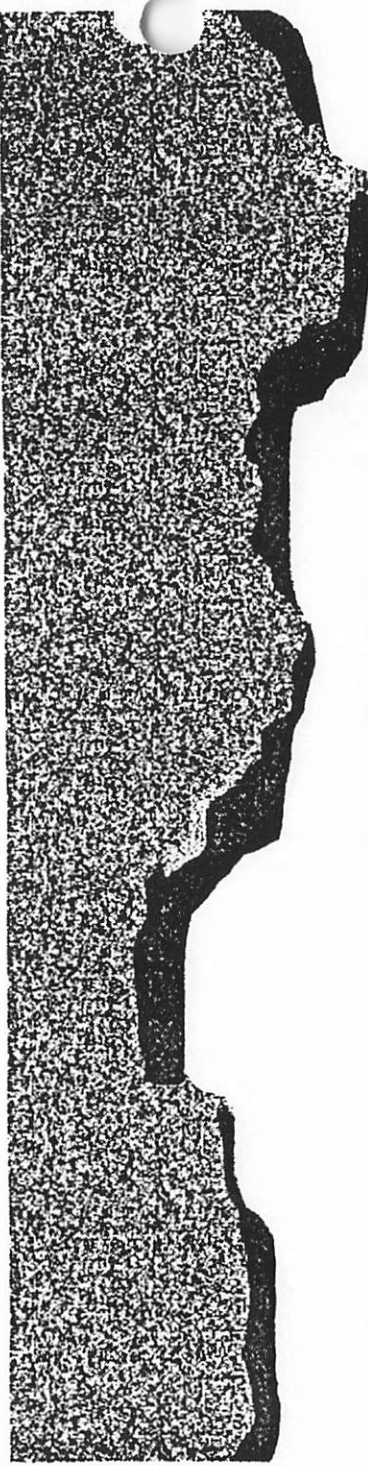


Quality Assurance and Quality Control Guidelines

Final Report Prepared for the
Office of Technical Assistance
and Safety

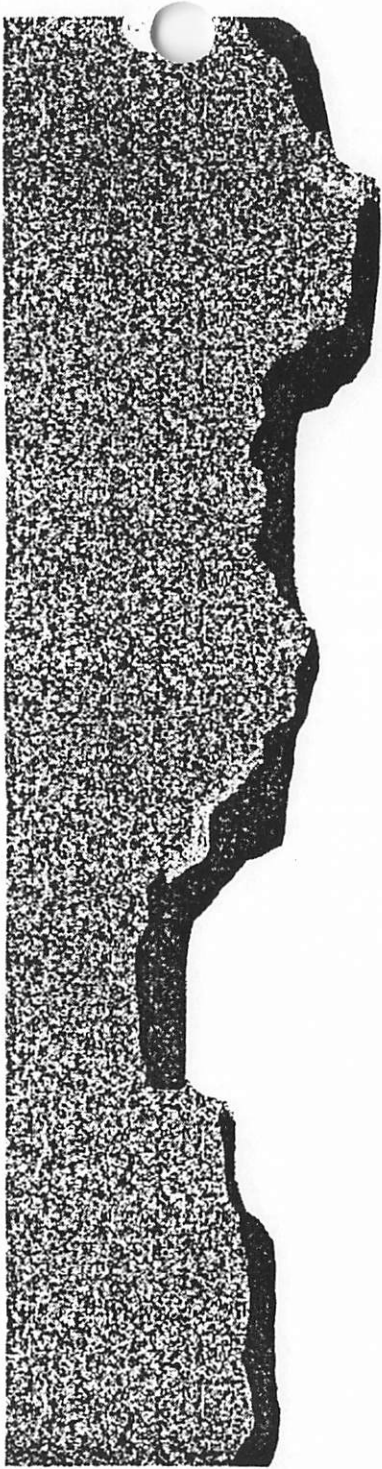
Urban Mass

Transportation Administration



Developing a Project Quality Plan

- ◆ Goals and Objectives
- ◆ Responsibilities
- ◆ Approach
- ◆ Technical Requirements During Each Project Phase
 - Project Planning
 - Preliminary Engineering & Final Design



(Cont.)

- Construction and Equipment Procurement
- Testing and Start-up

FTA Requirements vs. Contractor's Proposal

FTA Reqments.	IMMSJ Plan
Management Responsibility	Management Responsibility
Documented Quality System	Quality System
Design Control	Design Control
Document Control	Document & Data Control
Purchasing	Purchasing
Product ID & Traceability	Product Identification & Traceability
Process Control	Process Control
Inspection & Testing	Inspection & Testing
Inspection, Measuring & Test Equipment	Control of Measuring & Test Equipment

Inspection & Test Status	Inspection & Test Status
Nonconformance	Control of Non Conforming Product
Corrective Action	Corrective & Preventive Action
Quality Records	Control of Quality Records
Quality Audits	Internal Quality Audits
	Training
	Contract Review
	Control of Customer-Supplied Product
	Handling, Storage, Packaging, Preservation, & Delivery



QA/QC Transportation Areas of Concern

- ◆ **Documentation of Nonconformances**
- ◆ **Inspection Planning**
- ◆ **Documenting Inspections**
- ◆ **Program Training**

**UPR/MIT Tren Urbano Technology Transfer Program
Bayamón Alignment Section 1
January 13, 1997**

**Quality Assurance Program for
Rapid Transit Projects**

**Joseph G. Borden
Quality Assurance Manager
Stone & Webster Engineering Corporation
ICA Miramar Metro San Juan**

ABSTRACT

This paper describes the current Federal Transit Administration (FTA) grantee Quality Assurance Plans for major capital programs. It also includes the Federal Transit Administration's approach to Quality Management.

**Tren Urbano Technology Transfer Program
Bayamón Alignment Section 1**

INTRODUCTION

The latest U.S. Department of Transportation's Federal Transit Administration (FTA) Guidelines on Quality Assurance Programs for major transportation projects are issued and require organized documented Quality Assurance efforts on major capital projects. The FTA's recent Quality Program Guideline Documents are discussed in detail in this paper.

PROJECT AND CONSTRUCTION MANAGEMENT GUIDELINE

The first FTA document used to define the FTA's approach to quality is the "Project and Construction Management Guideline" manual issued in September of 1990 under the direction of the Office of Technical Assistance and Safety. This manual was recently updated and issued in 1996. This guideline addresses a set of management principles applicable to all new FTA funded capital improvement projects. The Project Management concept includes the requirement that the FTA grantee apply the management principles and guidelines unique to their project environment through the development of a Project Management Plan (PMP). The subject of Quality Management is included in an Appendix titled "Quality Assurance Program", which addresses many of the traditional Quality Management principles including organization, contractor and owner quality programs, owner audits, configuration control system wide engineering and other criteria.

QUALITY ASSURANCE AND QUALITY CONTROL GUIDELINES

The second FTA document used to define the Quality Program Requirements is the "Quality Assurance and Quality Control (QA/QC) Guidelines" document issued in March 1992. This document expands upon the QA/QC guidance contained in the Project and Construction Management Guidelines. Its major purpose as stated is to promote the development of grantee quality systems consistent with current FTA practices; and as I understand it, the FTA is currently planning to reissue this document.

ESSENTIAL ELEMENTS OF A QA/QC SYSTEM

The construction industry in the Rapid Transit field has lagged behind manufacturing, process constructors, and the nuclear construction contractors in the development of comprehensive QA/QC programs. In developing these QA/QC guidelines FTA has provided fourteen elements which have been adapted from the American National Standard for Quality Systems ANSI/ASQC Q0-94, and the International Standard for Quality Systems ISO 9000-ISO 9004. Consideration was given to adopting one of the construction specific guidelines such as, the ASQC "Quality Management for the Constructed Project", and the American Society of Civil Engineers (ASCE) "Quality in the Constructed Project". However, FTA capital programs for the transit industry generally include design, procurement and construction and it was determined that the ANSI/ASQC Q90 standards sets forth generic quality programs which are based on total quality management principals which are adaptable to all major transit capital projects. The fourteen elements set forth are:

1. Management Responsibility
2. Documented Quality System and Training
3. Design Control
4. Document Control
5. Product Identification and Traceability
6. Process Control
7. Inspection and Testing
8. Inspection, Measuring and Test Equipment
9. Inspection and Test Status
10. Nonconformance
11. Corrective Action
12. Quality Records
13. Quality Audits

PROJECT MANAGEMENT OVERSIGHT (PMO) CONSULTANTS

FTA maintains oversight for the grants which it awards, but assigns the grant administration and management responsibility to the grantees. FTA's Office of Grants Management normally delegates the responsibility for oversight to the appropriate Regional Office. The guidelines are therefore utilized in assessing a grantee's approach and performance in managing the capital grant project. The actual PMO activities are conducted by PMO consultants reporting to the applicable Regional Office. To avoid an organizational conflict of interest, these consultants are required to abstain from performing any associated activities for

the grantee during the performance of the PMO contract. There are approximately a dozen PMO consultants under contract to FTA overseeing a wide range of capital projects around the country.

AREAS OF CONCERN

Experience in performing both the support services contracts and PMO oversight activities, indicates that various quality program areas seem to stand out that require special attention in the establishment and implementation of quality programs to meet FTA guidelines. These key areas are:

Measures to ensure positive action in documenting and correcting nonconforming conditions.

Inspection planning and the documentation of inspection activities.

Training and the experience of inspection personnel.

It is my conclusion that efforts by FTA to impose mandatory requirements for quality assurance programs on major capital projects has a beneficial effect on both the construction contractors and the agencies, and that these efforts will promulgate to projects which may not be mandated by FTA guidelines.

References

1. US Department of Transportation, Office of Technical Assistance and Safety, Project and Construction Management Guidelines, National Technical Information Service, Springfield, VA, 22161, September, 1990, & 1996 update.
2. US Department of Transportation, Office of Technical Assistance and Safety, Quality Assurance and Quality Guidelines, National Technical Information Service, Springfield, VA, 22161, March 1992.

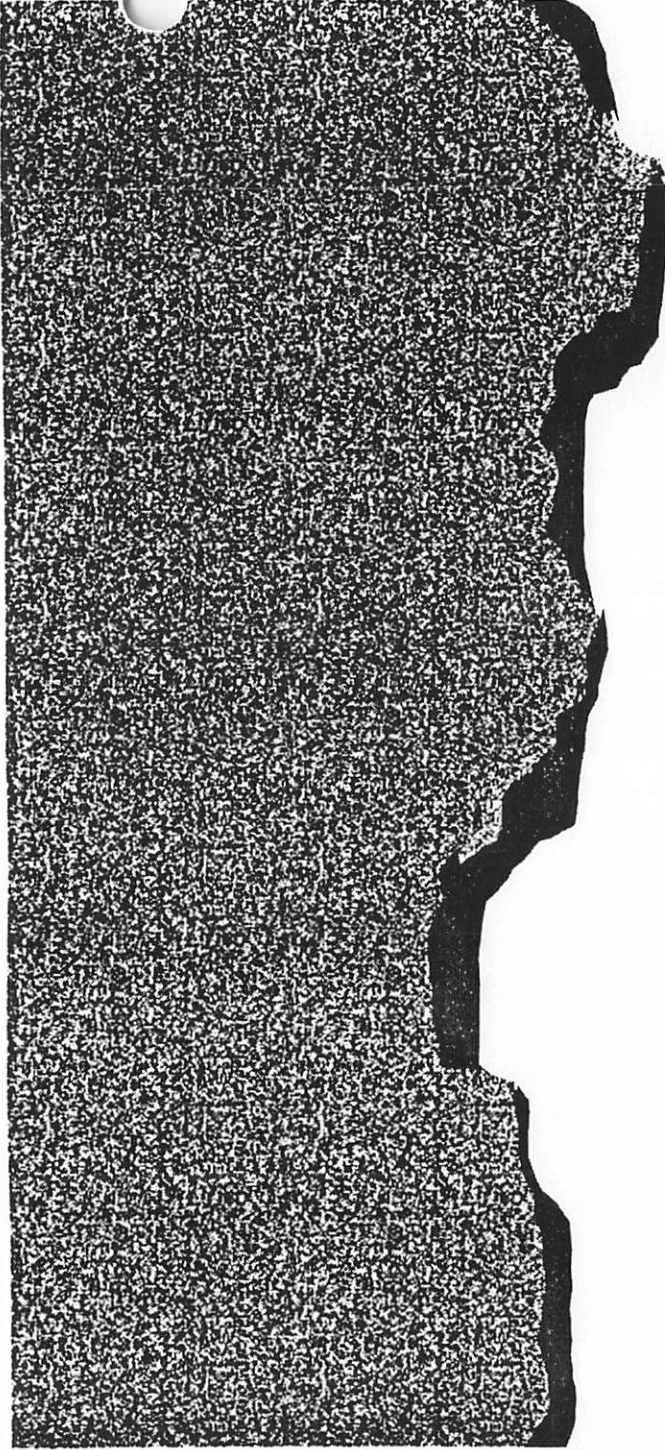
Tren Urbano Quality Assurance Program

In developing the Quality Assurance Program Plan for this Project , Tren Urbano has required that each Design Build Consultant establish a Quality Assurance Program Plan which address the criteria in the FTA Guidelines. In addition, Tren Urbano has expanded upon the basic criteria listed in the Guideline and has provided a more detailed interpretation in the Design Build Contract Document.

ICA Miramar Metro San Juan (IMMSJ) has developed and submitted a Quality Assurance Program manual to address both the contract documents and the FTA QA/QC Guidelines. The manual is currently in the final review stages and specific comments made by Tren Urbano are being incorporated in a new revision.

The general criteria utilized is as follows:

1. Management Responsibility
2. Quality System
3. Contract Review
4. Design Control
5. Document and Data Control
6. Purchasing
7. Control of Customer-Supplied Product
8. Product Identification and Traceability
9. Process Control
10. Inspection and Testing
11. Control of Measuring and Test Equipment
12. Inspection and Test Status
13. Control of Nonconforming Product
14. Corrective and Preventive Action
15. Handling, Storage, Packaging, Preservation and Delivery
16. Control of Quality Records
17. Internal Quality Audits
18. Training



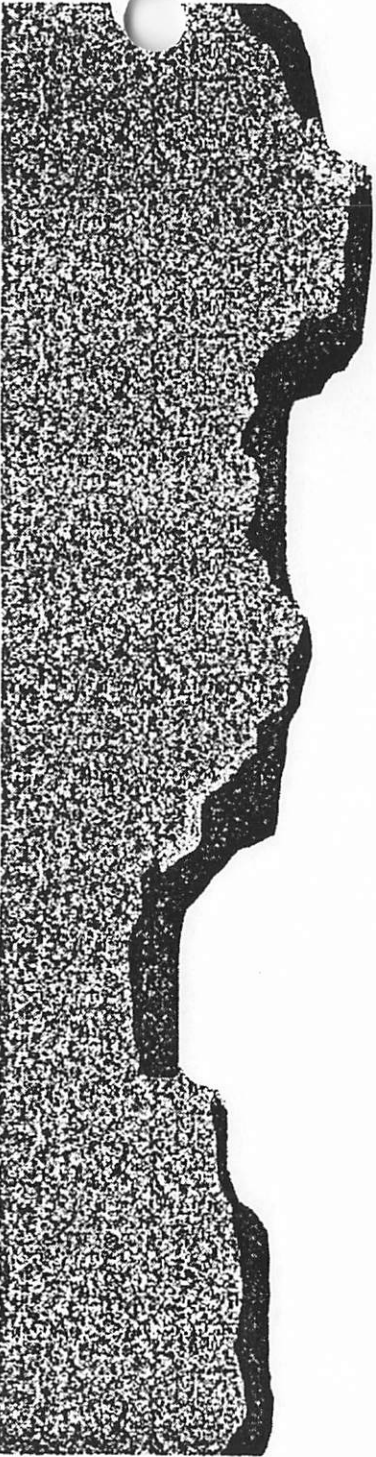
Construction Methods & Staging

Ing. Armando Romo
Construction Manager



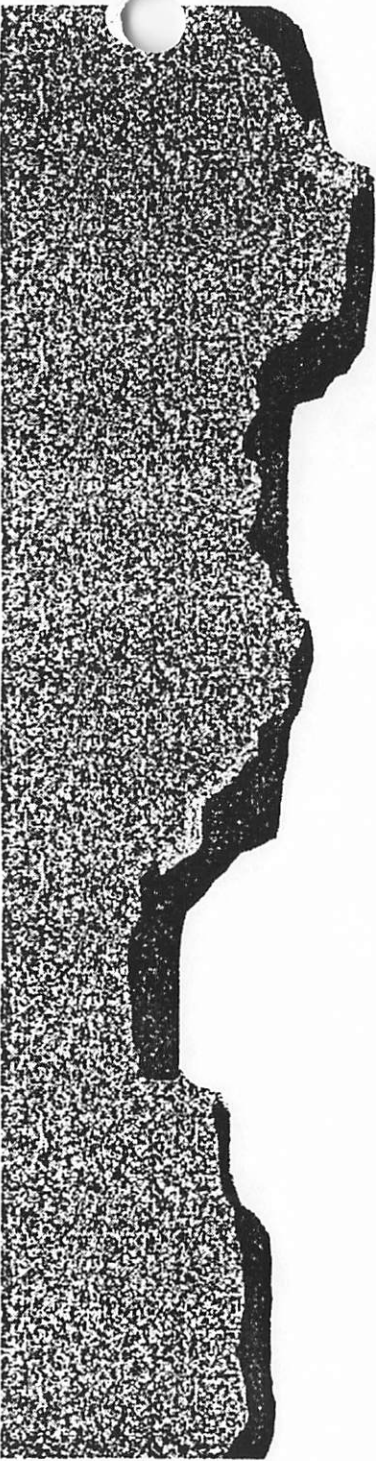
ICA-miramar
Metro San Juan, Corp.





Scope of Work

- ◆ **Bayamón Centro Station**
- ◆ **Complejo Deportivo Station**
- ◆ **Guideway**
- ◆ **Utility Relocation**
- ◆ **Coordination with other contractors**
- ◆ **Stairway Tower Reconstruction**



(Cont.)

- ◆ **General Gases Plant & PR-5 Retaining Wall Demolition**
- ◆ **Bayamón Gateway**
- ◆ **Roadway Improvements**

GRUPO METRO SAN JUAN

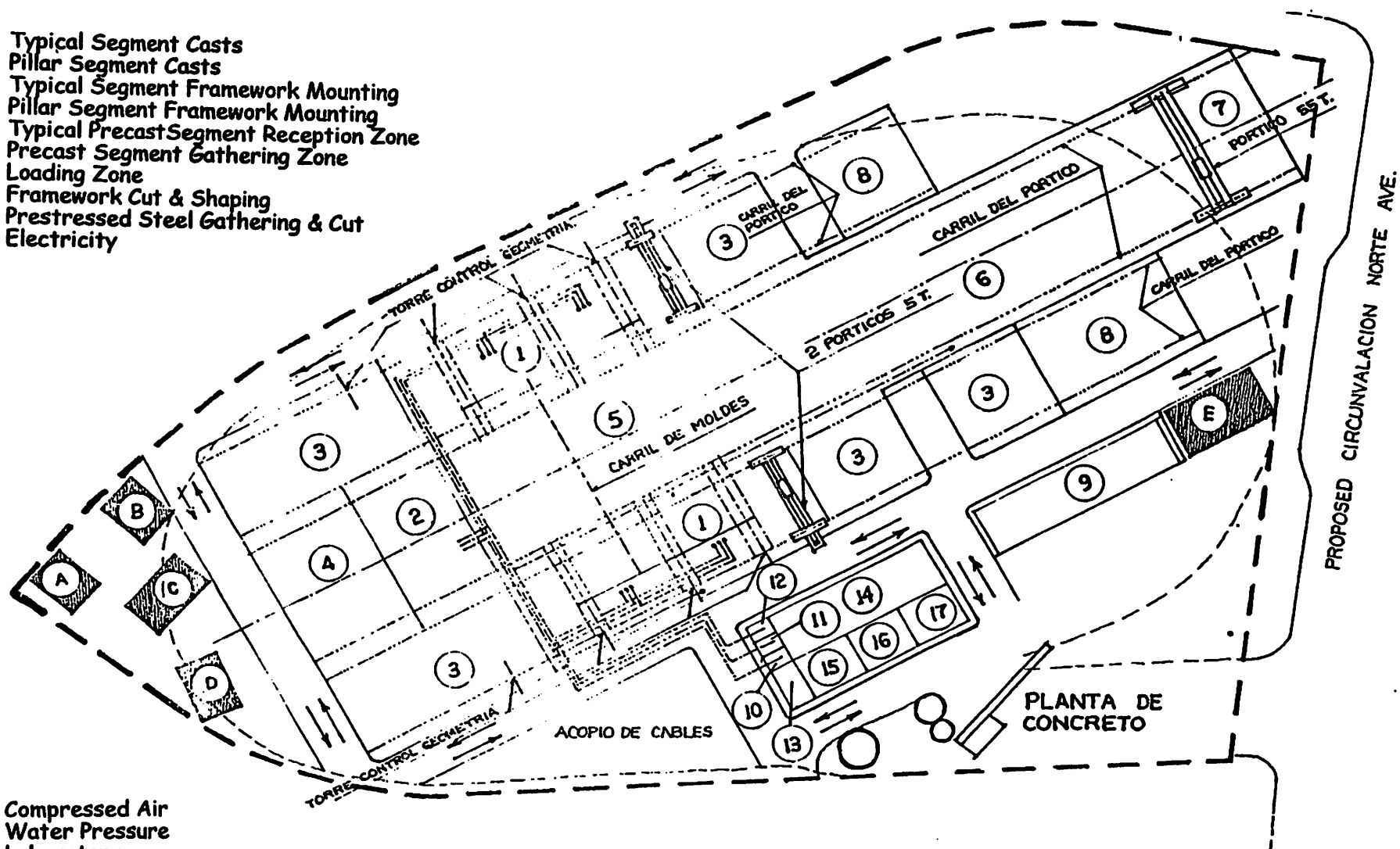


TREN URBANO PUERTO RICO

BAYAMON CONTRACT

CONSTRUCTION PROCEDURE

- 1) Typical Segment Casts
- 2) Pillar Segment Casts
- 3) Typical Segment Framework Mounting
- 4) Pillar Segment Framework Mounting
- 5) Typical Precast Segment Reception Zone
- 6) Precast Segment Gathering Zone
- 7) Loading Zone
- 8) Framework Cut & Shaping
- 9) Prestressed Steel Gathering & Cut
- 10) Electricity



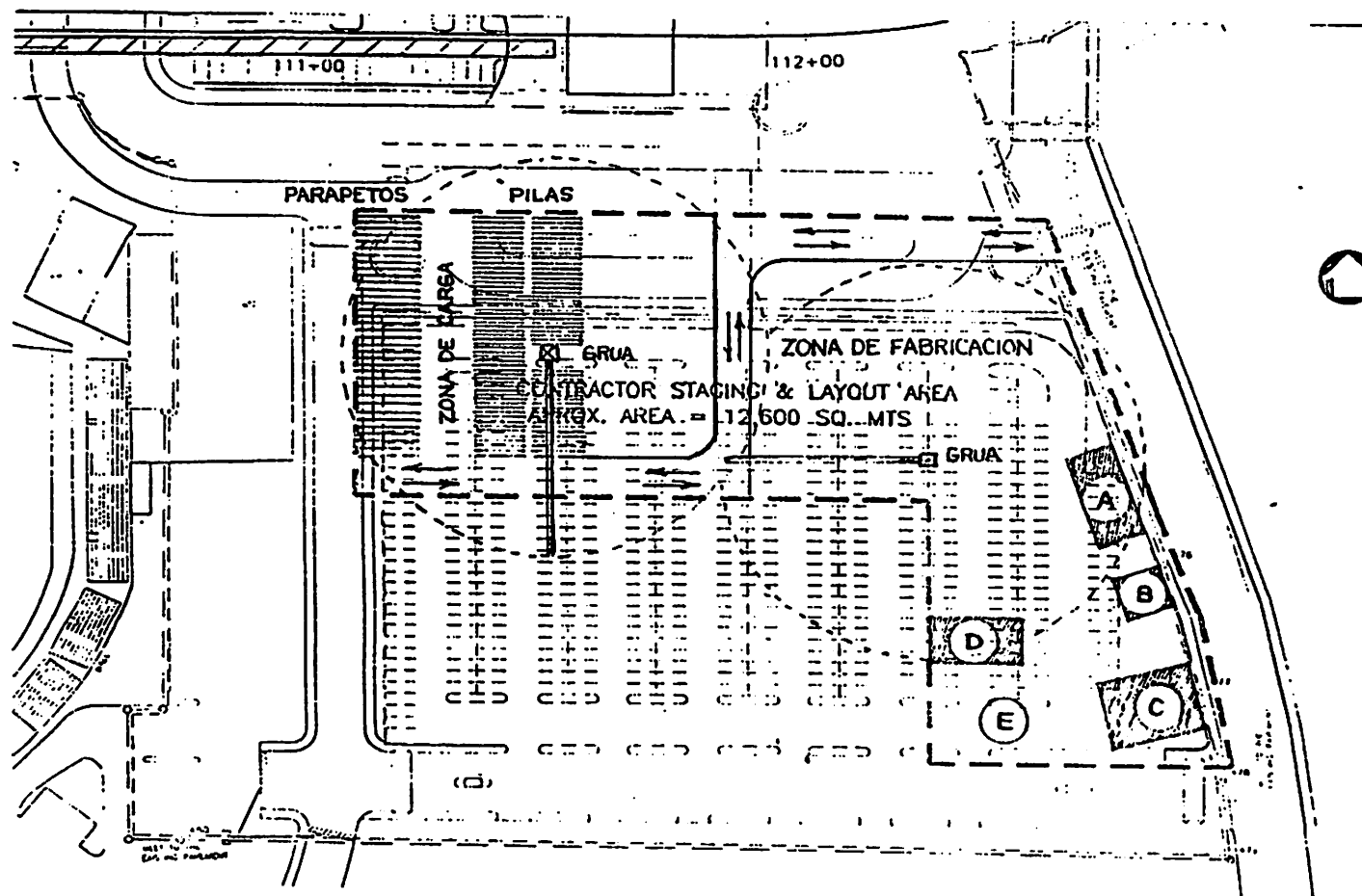
- 11) Compressed Air
- 12) Water Pressure
- 13) Laboratory
- 14) Storage
- 15) Electromechanic Workshop
- 16) Welding Workshop
- 17) Carpentry Workshop

Segments Plant

Concrete Plant

Bayamón Centro Parking Facilities

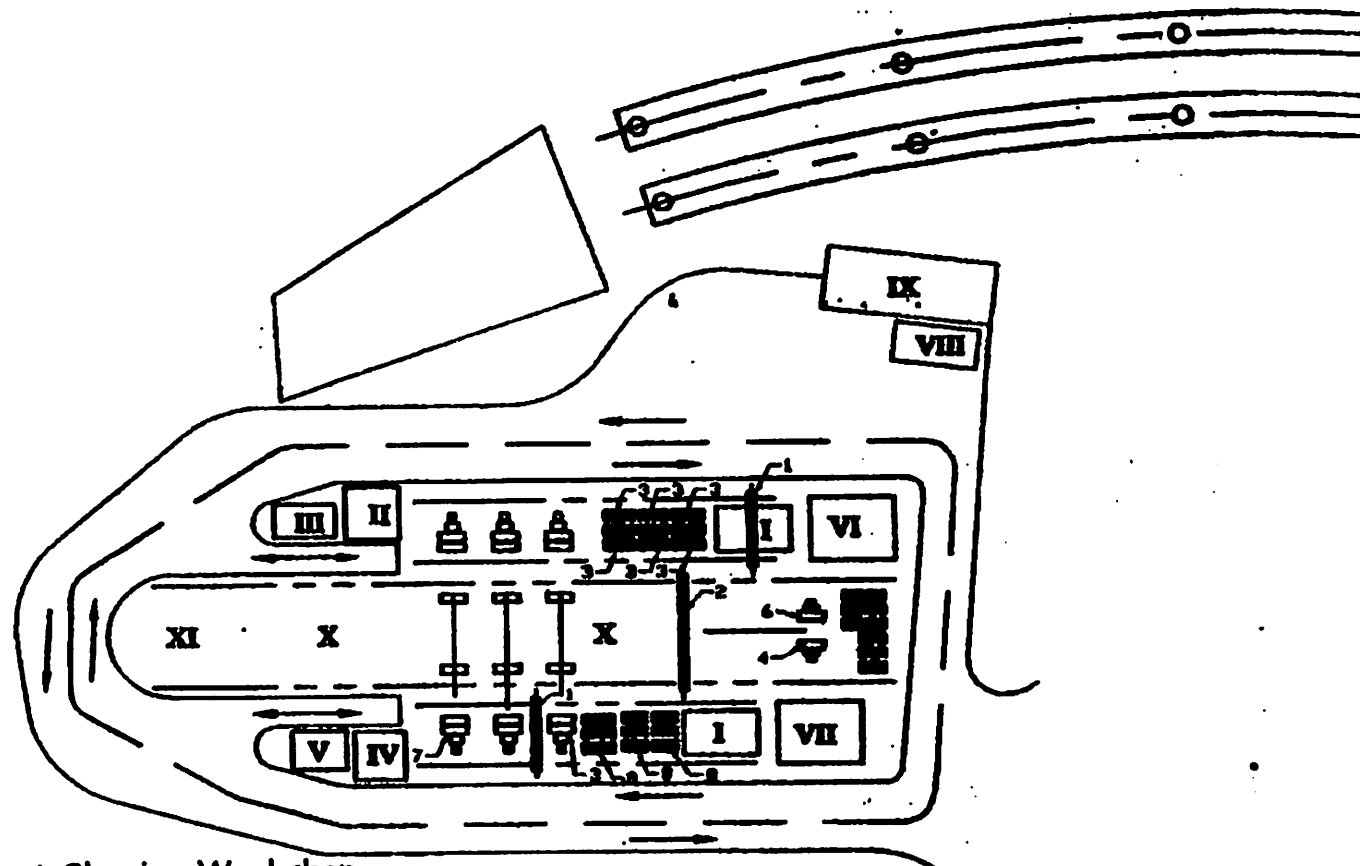
- A) Community Relations
- B) Training Area
- C) Technicians Office
- D) Segments Storage Site
- E) Eating Area



- A) Central Storage
- B) Administrative Office
- C) Central Office
- D) Eating Area
- E) Parking Facilities

Precast Plant
 Manufacturing and Storage
 Complejo Deportivo Parking Facilities

GRUPO METRO SAN JUAN



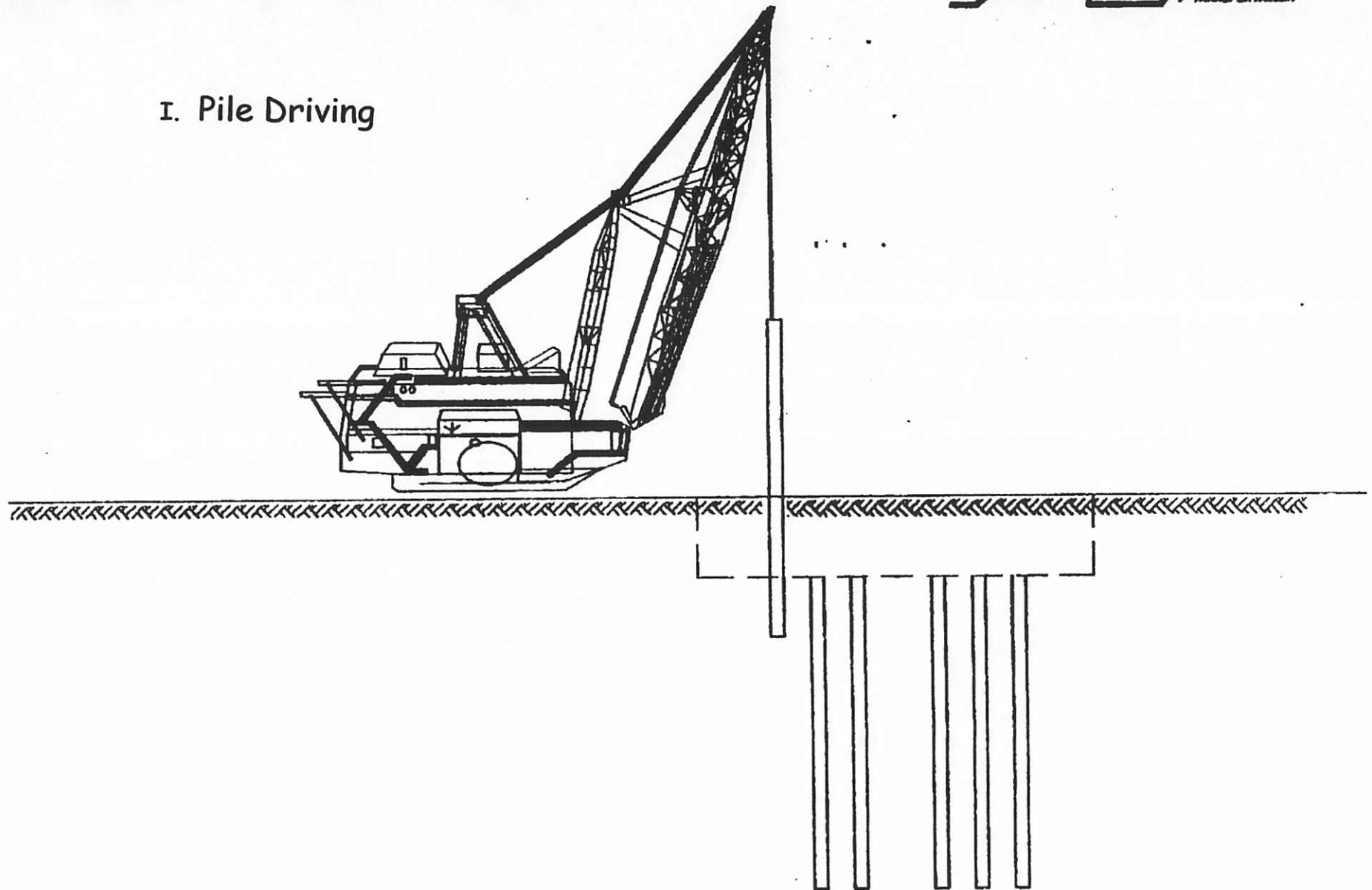
- I. Steel Reinforcement Shaping Workshop
- II. Electromechanic Workshop
- III. Welding Workshop
- IV. Carpentry Workshop
- V. Electric Power, Air and Water
- VI. Storage
- VII. Prestressed Cable cut & preparation
- VIII. Laboratory
- IX. Offices
- X. Segments Storage Area
- XI. Segments Loading Area

- 1. 18 m gantry crane
- 2. 25 m gantry crane
- 3. Cell for typical single track segment
- 4. Cell for expansion joint single track segment
- 5. Cell for typical dual track segment
- 6. Cell for expansion joint dual track segment
- 7. Cell for typical cantilever segment
- 8. Assembly area of reinforcement cages
- 9. Cages in storage position

GRUPO METRO SAN JUAN



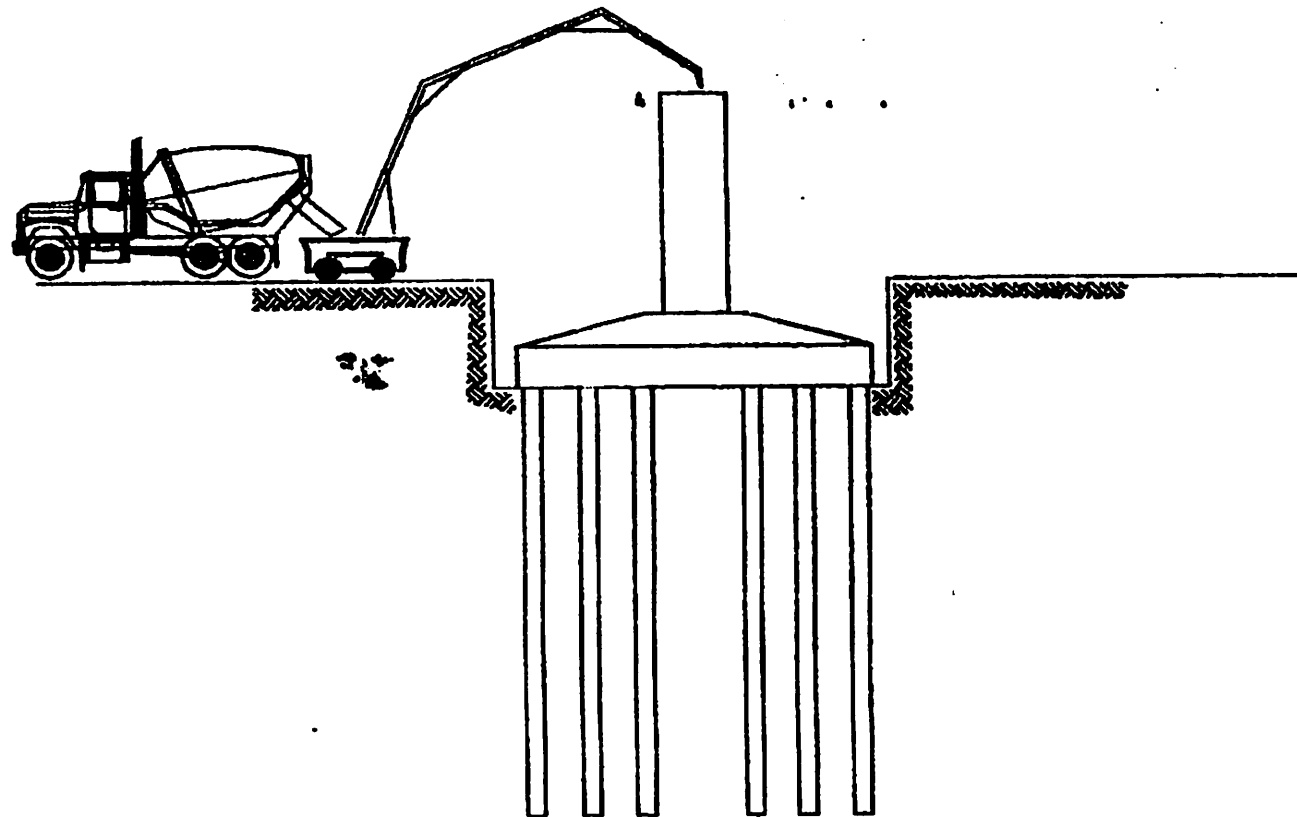
I. Pile Driving



GRUPO METRO SAN JUAN



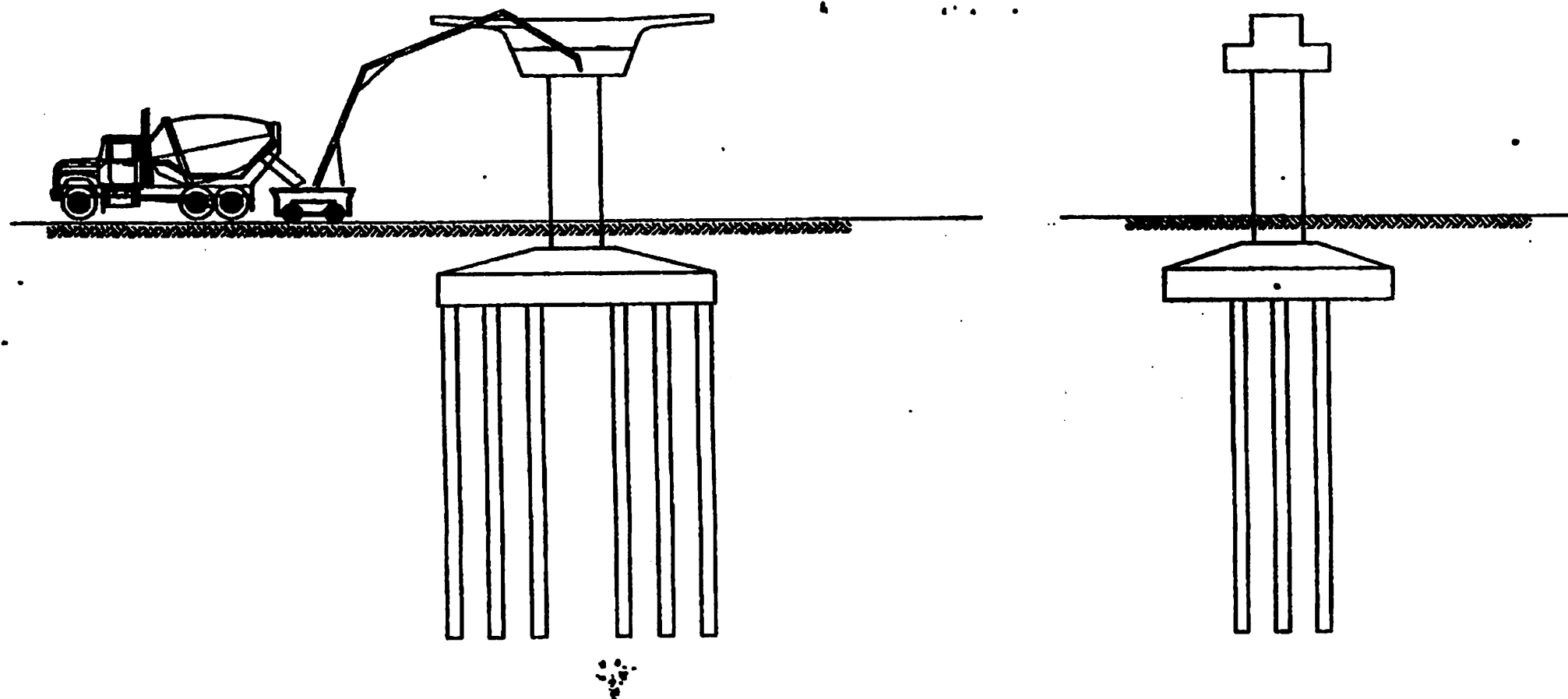
II. Footing and Column Pouring



GRUPO METRO SAN JUAN



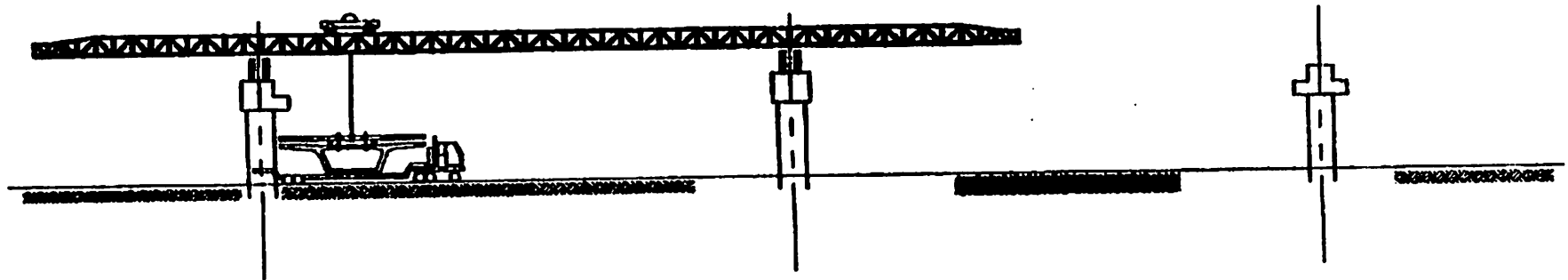
III. Monolithic Segment Support On-column Pouring



GRUPO METRO SAN JUAN



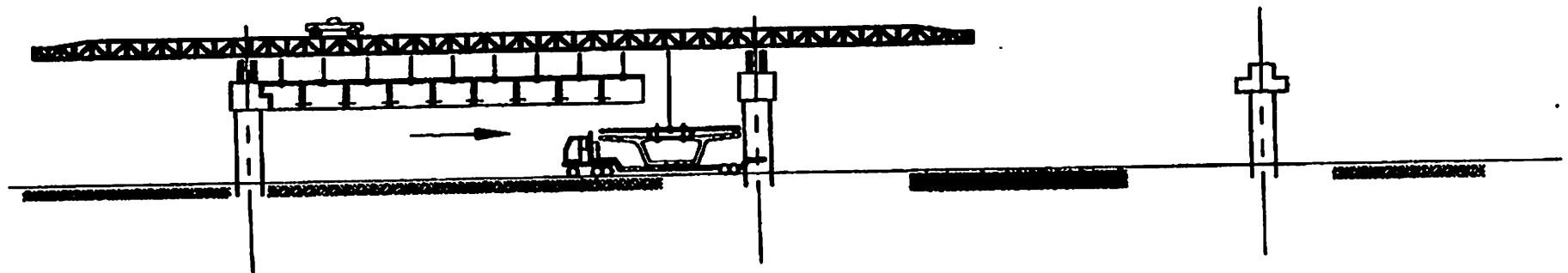
IV. Assembly Truss Erection- First Span



GRUPO METRO SAN JUAN



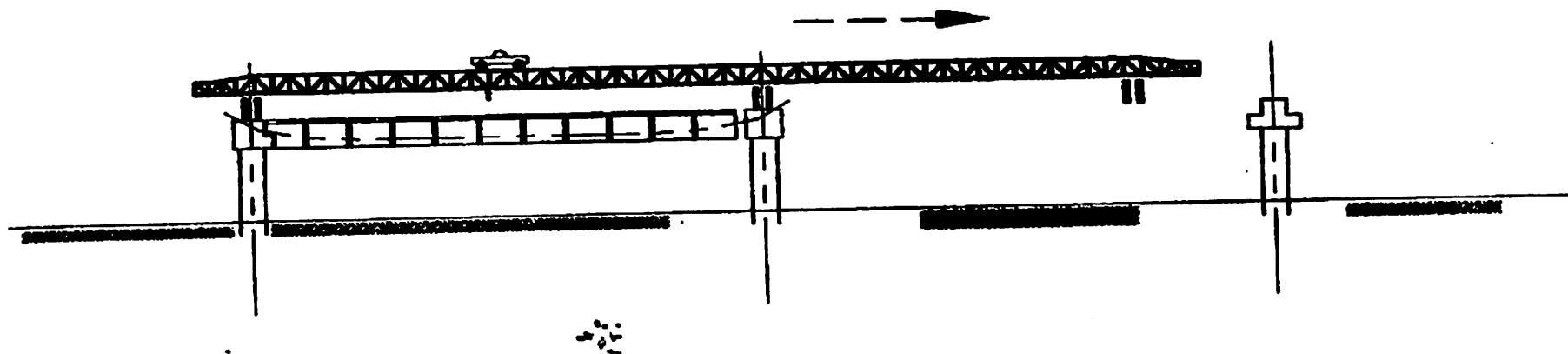
v. First Span Complete Assembly and Provisional Prestressing



GRUPO METRO SAN JUAN



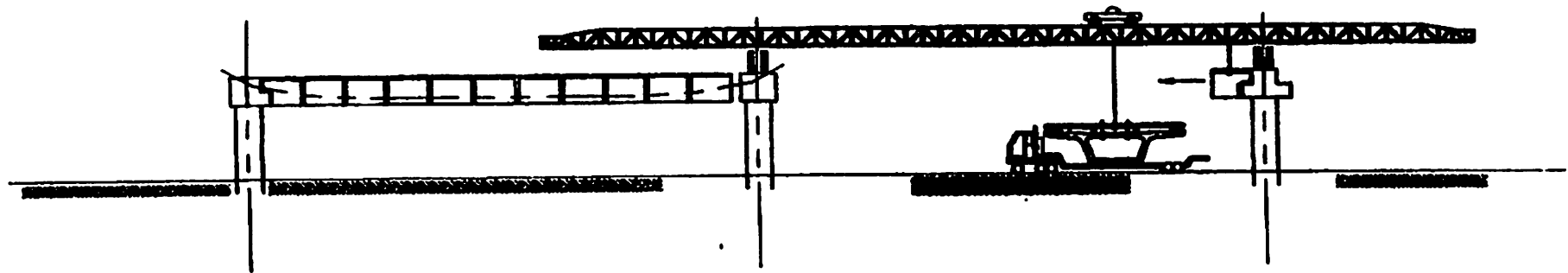
VI. First Phase Post-tensioning (Isostatic) and Truss Launching

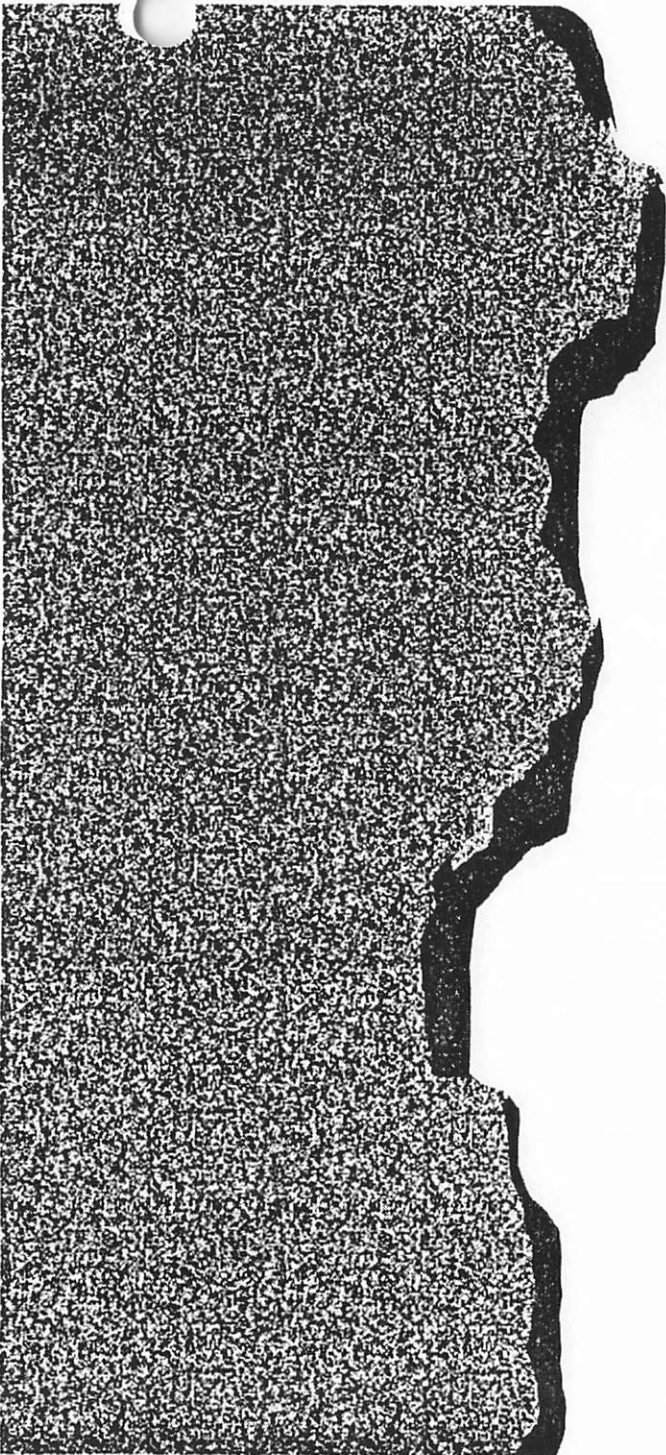


GRUPO METRO SAN JUAN



VII. Second Span Mounting (Same Operation as First Span)





Turnkey vs. Traditional Construction Projects

Ing. Enrique Salinas
Project Manager



ICA-miramar
Metro San Juan, Corp.



Construction Evolution

**TRADITIONAL
DESIGN &
CONSTRUCTION**



***PROPOSAL
*QUALITY ASSURANCE ADDED**



**MAINTENANCE IS
OWNER'S
RESPONSIBILITY**

**TURNKEY
PROJECTS**

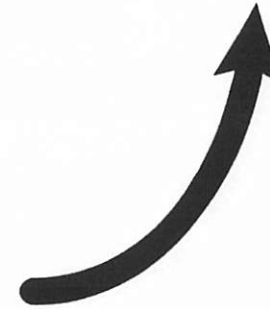


**THE
CONTRACTOR
IS THE SOLE
RESPONSIBLE**



**Plans
Studies
Design
Procedures
Quality
Assurance**

**Advantage: comply with norms
that guarantee the
safety of the facility.**



**CONCESSION
PROJECTS**



**THE CONTRACTOR HAS THE SAME
RESPONSIBILITY AS IN TURN KEY
PROJECTS**



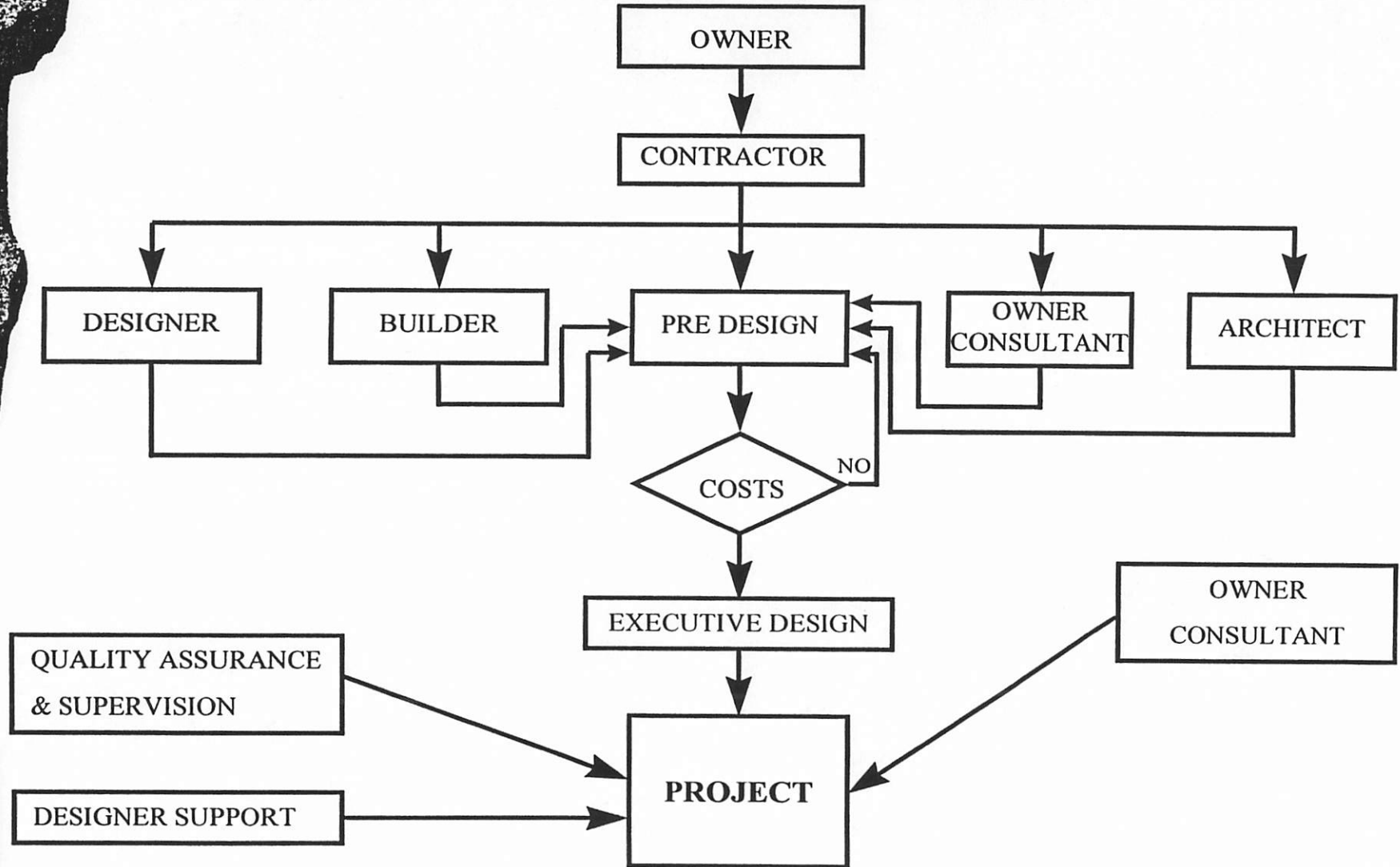
**ADDITIONAL
RESPONSIBILITY TO
DEVELOP
MAINTENANCE PLAN**



**THE PROJECT
MAINTAINS ITS DESIGN
CHARACTERISTICS
DURING CONCESSION**

Designer - Constructor Intertwine

- Advantage in turnkey projects
- Objective pursuant to norms, build safe projects & efficient



Maintenance

OBJECTIVE



**MAINTAIN THE STRUCTURE
CHARACTERISTICS DURING ITS WORKING
LIFE SPAN**

DESIGN



- **DEVELOP MAINTENANCE & OPERATION
PROCEDURES & MANUALS.**
- **AS- BUILT DRAWINGS.**
- **RECOMMENDATIONS ON SAFETY
PRECAUTIONS ON SPECIAL STRUCTURAL
ELEMENTS (CONTROL PILES,
SHOCK ABSORBERS & DISSIPATERS &
BEARINGS).**

OWNER



- **MAINTENANCE ACCORDING TO PROCEDURES
& MANUALS.**
- **KEEP THE ORIGINAL PURPOSE OF THE
FACILITY.**
- **SAFEGUARD ALL DOCUMENTS.**
- **MONITOR ON A BASIS THE FACILITY.**

Traditional Issues



**BID
PROPOSAL**

- THE NORM STATES THAT THE PROCEDURE TO AWARD A PROJECT IS BY BID.
- GENERALLY THE LOWEST BIDDER WINS THE PROJECT.

COMMENTS

- NOT CONVENIENT TO ASSIGN TO LOWEST BIDDER.
- A LOW ECONOMIC RESOURCE PROJECT IT'S NOT STUDIED PROPERLY.
- RESULTS IN LESS SAFE & MORE EXPENSIVE PROJECTS.
- NON OR MINIMUM CONSTRUCTIVE PROCEDURE APPROACH .

