



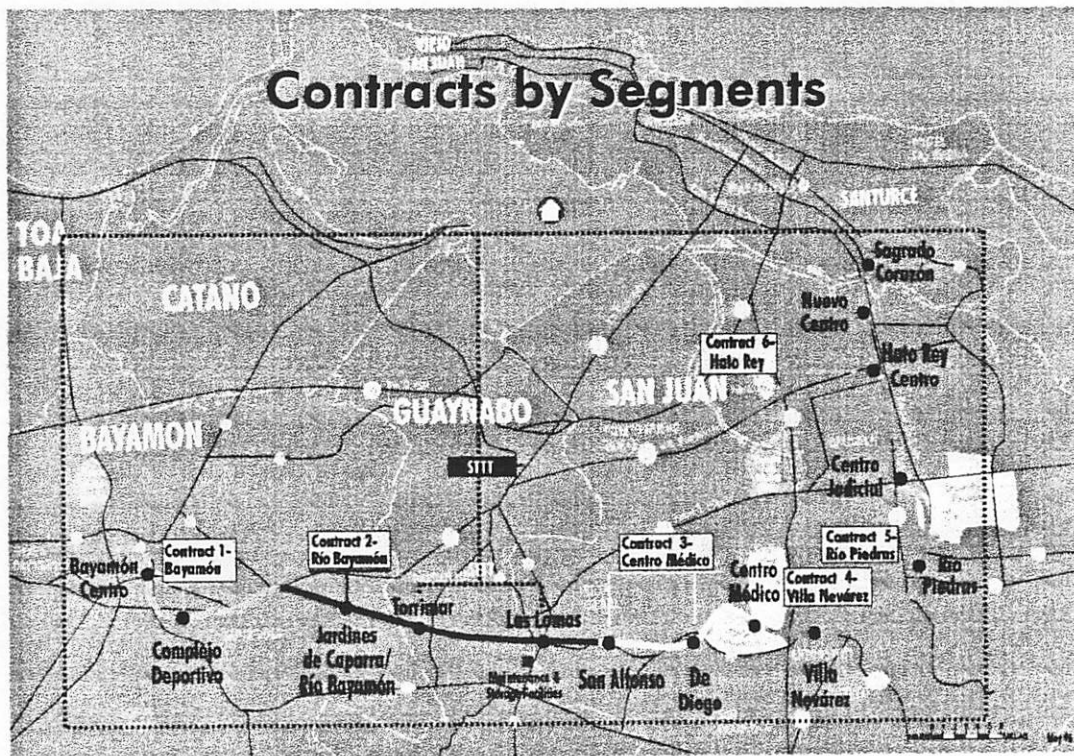
Tunneling By Design-Build

By James Francomacaro

Tren Urbano GMAEC

January 15, 1997

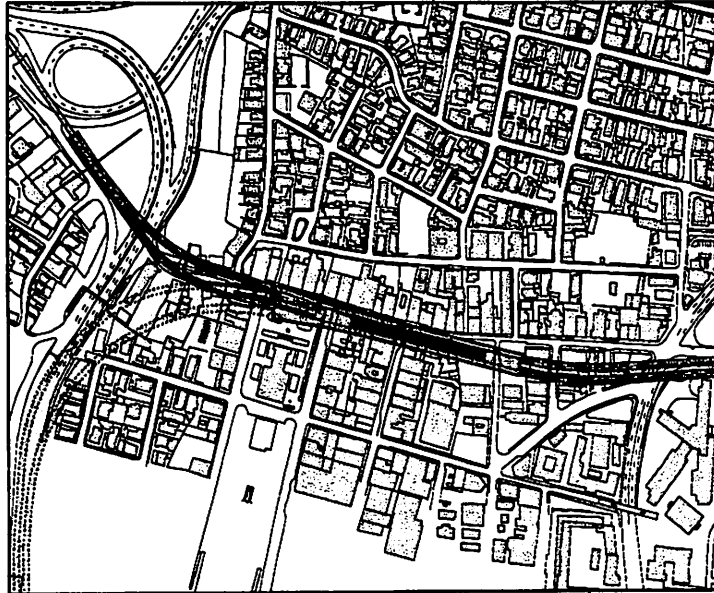




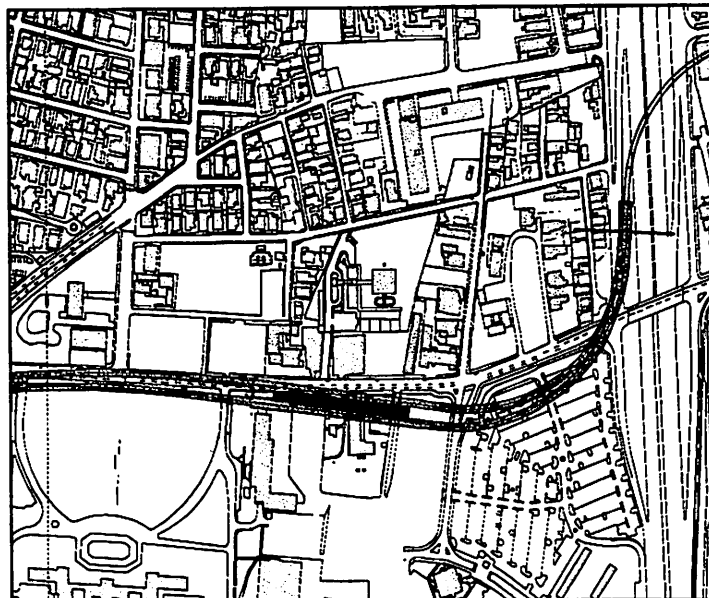
Tren Urbano Overview

- 17 Km rail project through San Juan
- Completion 2001
- 15 stations
 - 2 underground
 - 9 elevated
 - 4 retained cut
- 7 Design-Build Turnkey Cotracts
 - 6 Alignment section contracts
 - Systems & Test Track Turnkey (STTT)
- 2 Phase Procurement Process

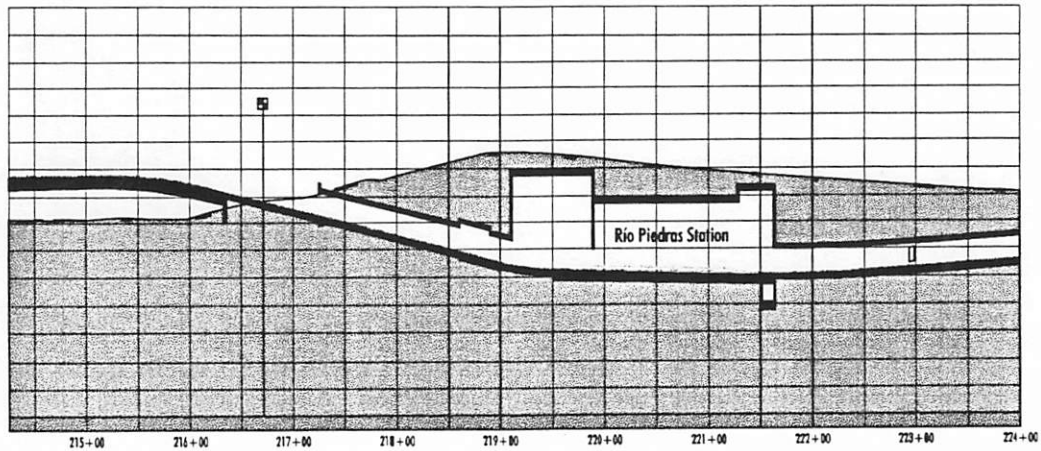
Río Piedras Alignment Plan- South



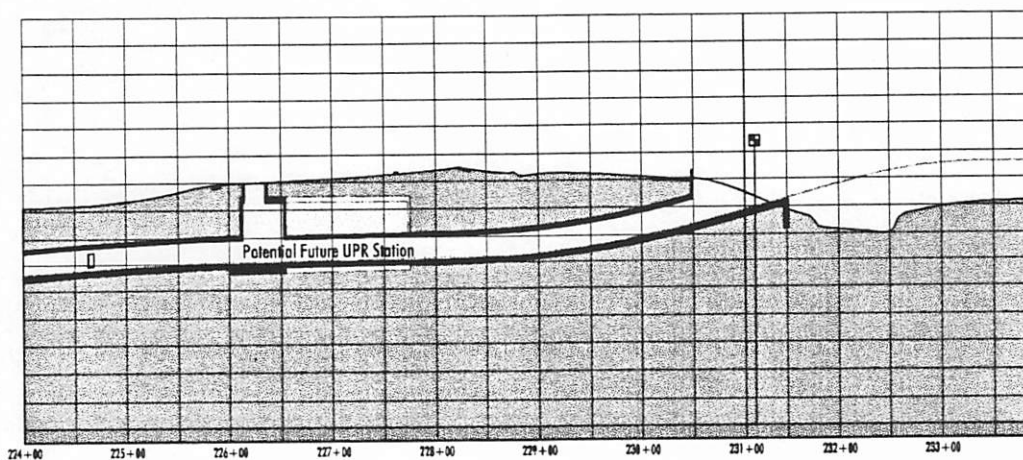
Río Piedras Alignment Plan- North



Río Piedras Profile- South



Río Piedras Profile- North



Scope of Rio Piedras Contract

- 1440 meter, overall
- Two Stations
 - Rio Piedras
 - UPR
- Two Portals
- Underground Trackway
 - Cut and Cover
 - Driven Tunnels
 - Mined
- Utilities Trackways
- Surface Restoration/Improvements
- Mechanical/Electrical (shared w/ STTT)

Rio Piedras Contract

Underground Construction Methods

Portals (<i>south & north</i>)	125 m
Cut and Cover Trackway (<i>south & north</i>)	500 m
Mined Trackway	50 m
Mined Station (Rio Piedras)	130 m
Driven, twinbore tunnels	435 m
Cut and Cover station (UPR)	<u>200 m</u>
Total	1440 m

Utility Work

- **Southern Half Alignment**
 - **Replace or relocate all utilities.**
 - Water
 - Sewer
 - Storm Drain
 - Electricity
 - Gas
 - Telephone
 - Cable TV

Utility Work

- **Northern Half Alignment**
 - **Replace or relocate only water bearing utilities.**
 - Water
 - Sewer
 - Storm Drain

Utility Work

- **Replacement/Relocation Responsibility**

- | | |
|------------------|------------------------------|
| ■ Water | Río Piedras Contractor |
| ■ Sanitary Sewer | Río Piedras Contractor |
| ■ Storm Drain | Río Piedras Contractor |
| ■ Electricity | Río Piedras Contractor |
| ■ Gas | San Juan Gas |
| ■ Telephone | Puerto Rico Telephone Co |
| ■ Cable TV | Cable TV of Greater San Juan |

Mechanical and Electrical Equipment

- | | |
|----------------------------------|--|
| • Connection to 480 V Switchgear | • Attendant booth enclosures |
| • Lighting | • All conduits |
| • Wiring and controls | • Fire suppression system |
| • Station ventilation | • Uninterruptable emergency power |
| • Station air conditioning | • Support for communications and signs |
| • Plumbing | |

System Elements By STTT Contractor

- **Trackwork**
- **Train control**
- **Communications**
- **High voltage traction power cables**
- **Traction power substation**
- **Elevators and escalators**

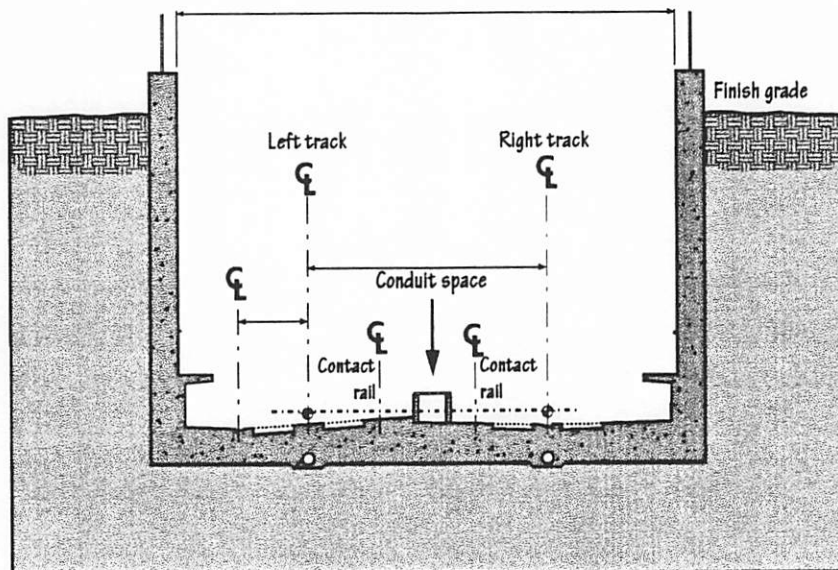
System Elements By STTT Contractor (continued)

- **Signage and graphics**
- **Fire detection system**
- **Fire management panel**
- **Intrusion and emergency alarms**
- **Electronic equipment in the attendants booth's.**
- **Fare collection equipment**

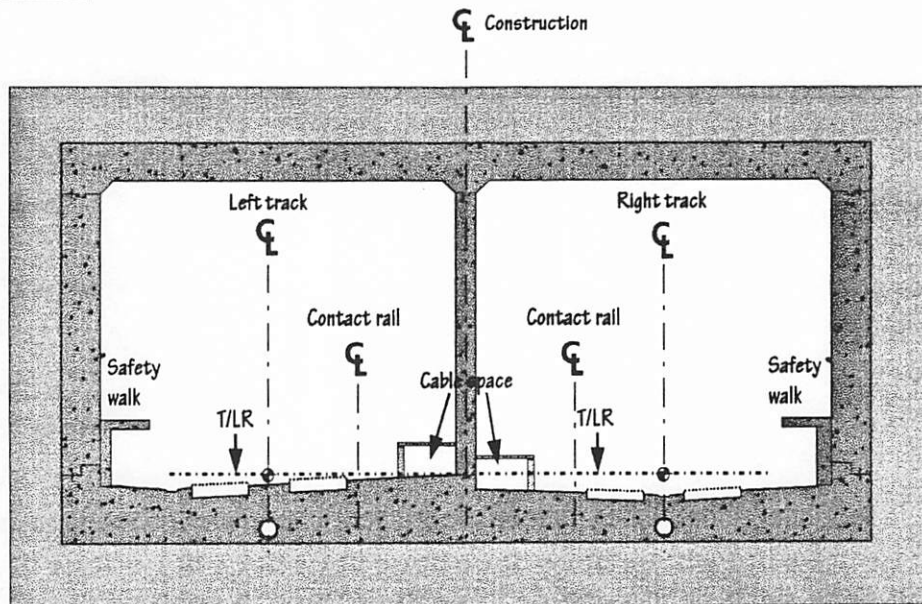
Río Piedras Schedule

- Proposal discussion 6/96 to 3/97
- Proposal Due 11/96
- Final Proposal Due 2/97
- Award 3/97
- Notice to Proceed 3/97
- Design and Construction 3/97 to 10/00
- Trackway Availability 2/00
- Completion 12/00

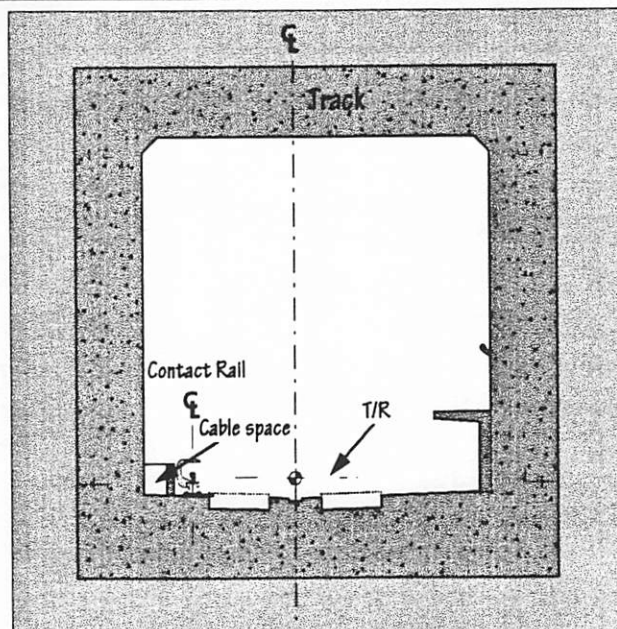
South Portal

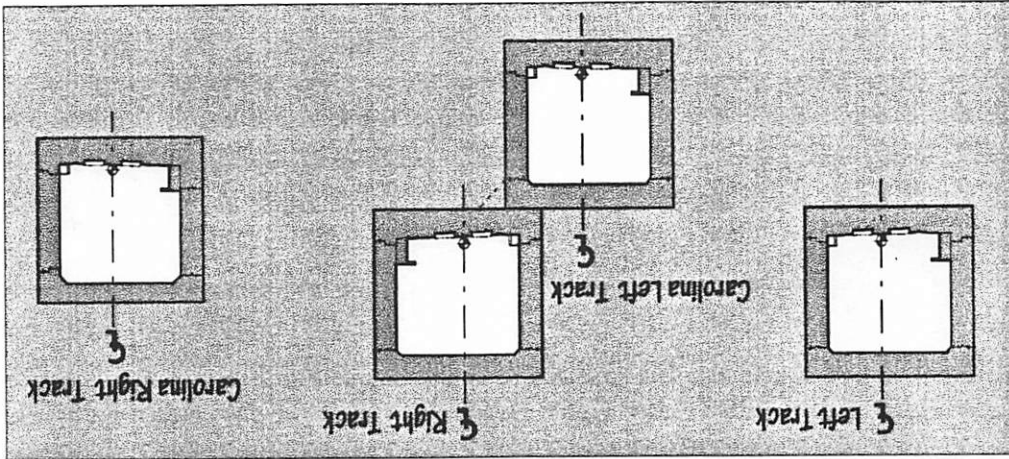


Double Cut and Cover Box

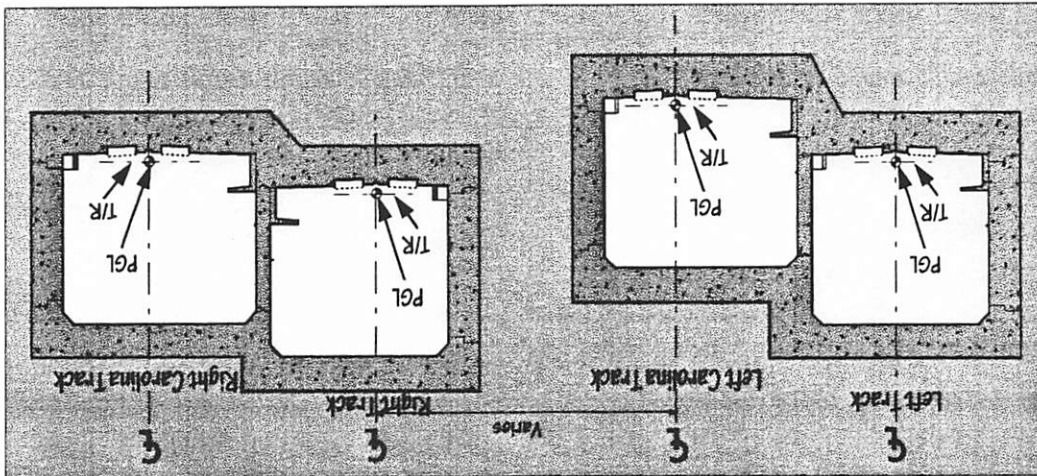


Single Cut and Cover Box



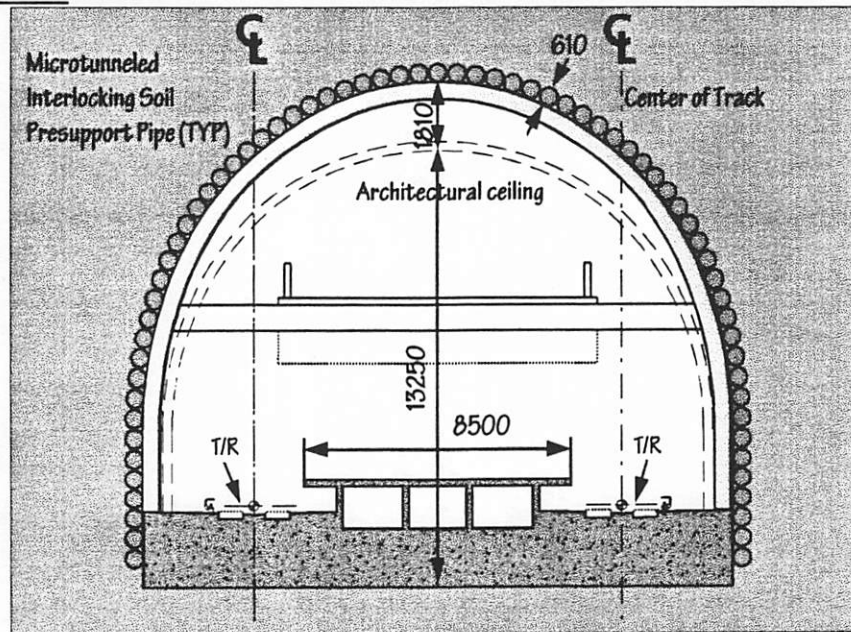


**Cut and Cover Trackways
at Junction to Carolina**



**Cut and Cover Trackways
at Junction to Carolina**

Microtunneled Arch



Circular Driven Tunnels

