2004 AREMA ANNUAL CONFERENCE

NEW JERSEY TRANSIT’S SECAUCUS RAIL HUB

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INTRODUCTION
The Frank R. Lautenberg Rail Station at Secaucus Junction is a major mass transportation complex located in the New Jersey Meadowlands (Secaucus, Hudson County, New Jersey). It is an integral part of NJ Transit’s “Urban Core Program”, an assemblage of railroad improvement projects specifically undertaken to transform the state’s fragmented commuter rail network into an efficient, coordinated system. Upon its completion in December 2003, travel by rail has been vastly improved, as all existing and future rail lines serving Northern New Jersey will be accessible from Secaucus. The centerpiece of the program is the new Station that serves as the interconnecting node for 10 of 11 NJ Transit (NJT) commuter rail lines serving Northern New Jersey. The site is unique as it is at the junction of AMTRAK’S Northeast Corridor (NEC), three NJ Transit Lines (Main, Boonton and Bergen County), as well as Norfolk Southern’s Croxton Yard. The scope of the project was first conceived in the 1960s and resurfaced again in the early 1980s. The Northeast Corridor is the principal railroad corridor from Boston to Washington D.C., and it is one of the most heavily traveled corridors in the country.
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The station permits rail commuters to transfer from the NJT Main, Bergen County, Pasack Valley and Port Jervis Lines to trains traveling on the Northeast Corridor. Benefits include shortened travel times to and from midtown Manhattan by about 15 minutes each way while also allowing for improved intrastate rail travel. Design of the expansion of the Northeast Corridor represents a major component of an overall program to improve capacity and efficiency of trans-Hudson and intrastate rail commutation for some 32,000 passenger trips per day. The Program is a Public/Private cooperative effort, as the station site is planned to accommodate a substantial private commercial development proposed by Allied Junction Corporation; and provides a future destination for some 12,000 office, hotel/conference center, and retail commercial employees.
This rail and commercial complex will also eventually be connected to an extension of the New Jersey Turnpike, as well as local roadway expansion (See attached Figure – Station Access Roadway Network).

The primary objective of Northeast Corridor Line rail modifications was to provide for safe and efficient stopping of certain NJ Transit and AMTRAK Northeast Corridor Line trains at the proposed transfer station. Achieving this new station stop required expansion of the Northeast Corridor Line to four tracks, with the two outside tracks for through service and the two inside tracks for stopping and commuter-destinating or transferring trips. Incorporated in such a design was the ability to provide a fifth track in the future for a reinstituted West Shore Line, and provision for a “pocket track” for storage of Northeast Corridor Line trains. The NEC was expanded from two to four tracks between the existing Portal Bridge at the Hackensack River and Bergen Interlockings, a distance of approximately 11,500 feet. These four tracks and complex track configuration allows AMTRAK through service to continue unimpeded on the NEC, while NJ Transit trains stop for passengers at the new 3-platform station. The high-speed track configuration also allows for the use of AMTRAK’S new high-speed ACELA train. These modifications accommodate an increase to the number of peak-period NEC trains in this portion of the NEC from 17 to 26 trains per hour. The $610 million program is comprised of 4 Phases, as depicted on the attached Figure (Secaucus Transfer Program – Design/Construction Phases).
Early in the Conceptual Phase of the Project it was recognized that the site provided numerous obstructions and restrictions including wetlands, floodplain, soft organic soils, boulder-filled embankment, limited access and ROW, overhead 138kv transmission lines. In depth analyses were performed to prepare a design which would accommodate all restrictions while being cost effective and constructible given the ultimate restriction of the Railroad environment. Multiple track alignment configurations to address high-speed merging and diverging moves off the Northeast Corridor were prepared using acceleration and deceleration capabilities of the locomotives, while providing turnouts and crossovers to access any platform from each of the 4 tracks. Great coordination was required with a related NJ Transit/Amtrak project, the High Density Interlocking System, which was necessary to support the expanded service anticipated.

Concurrently, track support alternatives were studied in depth (Embankment versus Structure). It was recognized that the 2 new outer tracks would be supported on structure/viaduct to minimize environmental impacts and considering geotechnical conditions, while surcharged embankment would be incorporated at the ends to tie-in. Due to the magnitude of the effort evolving it was decided to let out multiple construction contracts, while working closely with the Railroad to provide a design acceptable to the Railroad, while being efficiently constructed.
The expansion of NEC took place in two stages; Stage 1. Build the outer 2 tracks, and 2. Replace the interior 2 tracks upon relocation of traffic to the new outside tracks. Elaborate construction staging plans were developed, and integrated with CPM schedule to define all tasks and assign durations and milestones. The project site was delineated into 10 zones, each separately tracked to expedite the tasks.

The design team met with AMTRAK and NJT on a regular basis to develop the necessary procedures to expedite construction. AMTRAK was extremely sensitive to any activity which could “potentially” settle the tracks or could “foul” the tracks. Fouling was defined as any
equipment or material which could “potentially” reach within a distance of 15’ from centerline of track or 10’ of overhead wires. Elaborate procedures to install piles/caissons were specified.

Much of the project work was performed between trains – not very many opportunities given the busy operations. The greatest working windows were at night between the hours of 11:00 p.m. and 5:00 a.m. EK worked closely with AMTRAK to “cluster schedule” an adjustment to the schedule throughout the day (but especially at night) to expand the working windows. A train dispatcher was on site to coordinate and alert the Contractor of availability of opportunities to perform work close to the Railroad which would not normally be allowed. Work progressed across the site concurrently and expeditiously with these rules established. These procedures allowed for 20 cranes to work simultaneously on-site during the Foundations Contract. This resulted in major benefits for the project, including reduced construction costs and shortened project duration.

The work was then broken into 5 Construction Contracts: 1) Earthwork and Construction Access Roads, 2) 138kv Relocation off-site, 3) Foundations for Outer Tracks, 4) Superstructure for Outer Tracks, 5) Interior Bridges (See attached listing of Construction Contracts). The project began with a contract to place earthwork (including surcharging organic soils), and to construct access roads. Timber trestles supported on piles were needed over ponds and wetlands, while geotextile matting was used over organic soils. The second Contract relocated the 138 KV
power line off-site to facilitate future foundation work. The new NEC eastbound and westbound track, viaduct/bridges were built parallel to and outside the existing NEC under a Foundation Contract and a Superstructure Contract. Subsequent to the completion of the Superstructure Contract and after the transfer of all rail traffic to the newly constructed outer tracks, a final Interior Bridge Contract was awarded to demolish and reconstruct the existing NEC tracks and bridges between the new outer tracks (See the attached typical sections for infrastructure configuration along the Northeast Corridor and the NJT Main Line). All railroad track, catenary and power distribution work was designed under this program and performed by AMTRAK and NJ Transit Forces.

Highly specialized track components were purchased under two track procurement contracts. The special trackwork consisted of 19 turnouts installed in 4 new interlockings, all located within 1 ½ miles of each other. Six (6) of the turnouts were classified at “high speed” and were used only once before in the U.S.

The new Station and the resulting track modifications required significant modifications to Amtrak’s Electrification system within the project limits, as well as to Hackensack and Kearny Substations. All of the existing catenary structures were replaced with new portal structures, and new cantilevers were designed for the track viaduct structure, as well as modifications to numerous existing structures. Also, all of the catenary was replaced and was brought up to
current standards. The Existing electrification system had 12kv feeders and 138kv transmission conductors supported near the top of the catenary poles. New feeders were required to support the revised sectionalizing, due to the new track alignment, and new breakers were required in Hackensack and Kearny Substations. The 138kv transmission was not included on the new catenary structures due to clearance constraints through the new station building. This required the design of a “run around” pole line to support the transmission, as well as to temporarily relocate the signal power to facilitate the new construction along the corridor. Additionally, Amtrak’s signal and communication system needed to be upgraded to support all of the modifications and we provided a new duct bank and cable tray system for all of the new cables required.

A total of 15 bridges and 8000 lf of viaduct were provided under this project. 14 bridges were traditional through girder design, while one was a deck girder structure, all founded on H-pile foundations. The Viaduct Structures were designed with 2-4’ diameter caissons substructure through the boulder-filled embankment. Hand-dug liner plates were incorporated to get through the boulders. Additionally, the dual rotary rigs required to drill pipe piles though boulder-filled embankment was an innovative approach to construct soldier piles and lagging 8’ from active track. Pipe pile bents were incorporated in areas outside the boulders.
Prestressed box beams were incorporated predominantly, while steel girders were used to transition from the viaduct to the bridges. The bridges were designed for Cooper E80 live load with diesel locomotive impact following the AREMA manual for Railway Engineering and AASHTO Standard Specifications for Seismic Design of Highway Bridges. The design life of the bridges is expected to be 100 years.

Deck plates and side ballast plates were waterproofed using a new sprayed-on membrane waterproofing system that underwent a year of testing by AMTRAK before being approved for use on the project. The girder designs were influenced by the vertical underclearances required for the below roadway and tracks and the NEC clearance envelope, which restricted the girder top of flange elevation to be no higher than the top of rail. Where possible, the girders were designed using grade 36 steel. However, it was necessary to use grade 50 steel for the longer spans and where clearance was an issue. Where underclearance was also an issue, the minimum ballast requirement of 1’-0” was reduced to 8” with a 1” thick ballast mat to minimize the overall superstructure depth.

The attached tabulation of Construction Facts and Figures indicates the magnitude of work of this Program.
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PHASE B – SECAUCUS TRANSFER STATION

The Frank R. Lautenberg Rail Station is a magnificent 312,000 square-foot mass transportation center/commercial development complex. The station is located along a corridor between the Jersey City waterfront and the Meadowlands Sports Complex and links to the New Jersey Turnpike. The new transfer station, located between New York and Newark’s Penn Stations, is a multi-level facility built on a 7-acre site in Secaucus, New Jersey. The station interconnects 10 New Jersey Transit commuter lines and facilitates easy transfer from one train line to another. The station was developed by galvanizing the private sector and public entities, and sharing the same common goal and exploring new ways of approaching traditional problems.

There are three primary levels to the transfer station; the NJT Main Line Platform Level, the NEC Platform Level, and the Station (Concourse) Level. Other levels within the station house maintenance and other operations at the facility.

The Main Line Platform Level is nearly at the same elevation as the street level. The foundation of the Main Line Platform consists of pile foundations at the low rise areas, and caisson foundations at the future high rise areas tied with grade beams in both directions. The station’s foundation system required careful coordination and communication so that it would not interfere with tracks and foundation of the viaduct structure. The Main Line Platform Level
consists of one-way slab, continuous concrete beams and columns supported on grade beams and pile caps. The Main Line Platform Level has a 2 platforms, 29’ wide x 760’ long.

The NEC Platform Level, which consists of 3 boarding platforms, is approximately 30’ above the street level. The foundation system of the NEC Platform Level consists of caisson foundations. Caisson sizes range from 3’-0” to 6’-0” diameter with permanent casings seated approximately 10’ into rock. The rock strata is approximately 90’ below the track level. The North and South Platforms are constructed of precast prestressed double tees spanning 30’ and supported on the double cantilevered steel beams. The center platform consists of a one-way concrete slab, concrete beams and double cantilevered concrete girders. The girders are supported on a single concrete column. Because of phasing of this project, dowel bar couplers and dowel bar splicers were utilized for concrete connections. The North and South Platforms are 26’-6” and 22’ wide by 1200’ long, respectively. The center platform is 37’-6” wide by 1200’ long.

The Station (concourse) Level is 50’ above street level. The floor of this level was constructed of 34” deep precast prestressed double tees with 4” structural topping supported on the precast prestressed girders. The girders are supported on composite columns. The typical bay size is 30’x 45’. The Concourse Level consists of a “Rotunda” which has a clear span of 135’x 135’ and clear ceiling height of 70’. This level also has clearstory windows along the perimeter with a
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50’x 50’ skylight. The roof over this level has a three-dimensional broken back steel frame. The composite column sizes are 36”x 36” and 36” diameter with steel column size varies from W14x 465 to W14x 730 and almost solid tube size 21”x21”.

The portion of the NEC platforms which are not covered by the station building consist of precast planks with structural topping supported on long span of precast prestressed box girders. The girders are supported on a 5’-0” deep hammerhead, which is supported on two 48” diameter concrete columns. The columns are supported on a pipe pile foundation system.

The scope of work for the previously mentioned construction contracts required for the Phase A NEC expansion also included building certain elements of the station. This included the building’s foundation, superstructure and various building systems. Additionally, several other contracts were utilized to install other important station components such as the passenger communication and information systems.

The foundation and columns of the station building already have provisions for the construction of future high-rise buildings over the station. The station has a flexible planning grid 30’x45’ which makes the high rise buildings work with track and platform dimensions. An intermodel transit hub, the Transfer Station was planned to support the future development of four 20 to 40-
story office towers, a 600 room hotel and conference center, and a 112,000-square foot retail concourse, plus a 4,400-car parking garage.

**PHASE C – MAIN-BERGEN CONNECTION AND MAIN LINE IMPROVEMENTS**

This phase was a major rail expansion project in support of the Transfer Station to facilitate platforms at one location on the lower level. The Main Line was expanded from two to four tracks for two miles about the Station. A new two-track viaduct spanning wetlands was also built at the northern extreme to connect the Bergen County Line (BCL) to the Main Line. This connection now allows all Bergen County and Pascack Valley Line trains to switch over to the Main Line for continued operations. This action frees up about 6,000’ of the BCL ROW to allow for roadway access by the Turnpike and to support the future development.

The structural design portion consisted of three distinct parts:

1. The design of two multi-span prestressed concrete box beam viaducts through wetlands, totalling approximately 2,400 feet long

2. The design of a staged culvert replacement under live railroad traffic in an environmentally sensitive area

3. The rehabilitation of a steel through girder structure under live railroad traffic.
Once temporary access roads were constructed, the multi-span viaducts were constructed in the wetlands by driving steel pipe piles to rock, placing precast concrete pile caps, and constructing precast prestressed box beams on the pile caps. In order to accommodate the placement of precast pile caps, pile-driving templates were necessary to maintain driving tolerances. Once the superstructure was placed, the entire area to receive ballast was coated with a sprayed-on waterproofing membrane. The use of the precast pile caps, precast prestressed box beams, and the sprayed-on waterproofing were all chosen to expedite the schedule for construction of these lengthy viaducts.

High-speed # 20 tangential turnouts and switch heaters were required to support the Interlocking necessary to accommodate new platforms and structures associated with the Station. Additionally, the widened embankment required surcharging with vertical drains to consolidate organic materials, along with the appropriate permitting.

Challenges included construction adjacent to active NJT rail lines, coordination with other ongoing projects in the immediate vicinity of the project, ROW issues, and environmentally sensitive areas.

PHASE D – TWIN ARCH BRIDGE AT NEW COUNTY ROAD GRADE SEPARATION
New County Road is one of the main vehicular arteries providing access to the new Rail Station. Prior to the commencement of construction, the road formed a grade crossing at its intersection with the Main Line. However, with the connection of the Bergen County Line to the Main Line, an expansion of the Main Line from 2 to 4 tracks, and the resulting increase in service, a grade separation was mandated to eliminate a potentially dangerous condition mixing cars and trains at the New County Road intersection (located just north of the Station). Elimination of the existing 2-track grade crossing of the Main Line at New County Road was accomplished through this phase of the Project.

The 2-lane roadway overhead evolved to a widened width with the anticipation of a future bi-directional third lane to accommodate future increase in traffic. The geometry of the grade separation was carefully developed in order to minimize right of way impacts to the maximum extent possible. The challenges faced throughout the utility relocation phase were largely due to the limited amount of right of way; and relocations had to be accomplished within an extremely limited area. Historically, there had been problems in managing the stormwater runoff throughout the project area. Providing adequate drainage was another challenge. Constant coordination was also required because of other projects being constructed in the area - both the New Jersey Turnpike Authority and the Town of Secaucus had projects adjacent to the site.
A major consideration was the aesthetics, as compatibility with the Station was necessary. Careful attention was spent in selection of the precast panel units for the retaining walls, light posts, and an ornamental railing was designed that was both functional and had an aesthetically pleasing, radial appearance from a distance.

NEW JERSEY TURNPIKE AUTHORITY ROADWAY IMPROVEMENTS

The NJ Turnpike’s Secaucus Interchange is a major roadway improvement undertaking in support of the overall Transfer Station and Rail Hub. A new interchange and toll plaza are currently under construction on the Eastern Spur of the Turnpike, and will connect to an extension of another local road, Seaview Drive, which is also under construction.

The Secaucus Interchange project provides for the construction of a new interchange and toll plaza facility located along the easterly spur of the Turnpike at MP 110.8. The project is approximately 1.8 miles in length and consists of two lanes in each direction. The toll plaza will have nine lanes. In anticipation of this work, NJ Transit constructed a bridge on the Northeast Corridor to allow the future roads feeding the plaza to pass below. The extension of Seaview Drive is the proposed connecting road between the Turnpike Interchange and Hudson County’s New County Road. The road will mostly be situated in Secaucus, but will also reach into Jersey City after crossing over Penhorn Creek. When completed, the road will extend beyond New County Road to join the existing portion of Seaview Drive, a Secaucus Town road which
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currently ends nearly one mile east from the intersection with Meadowlands Parkway. This roadway would traverse the heart of the Secaucus warehouse district. As a continuous roadway, existing Seaview Drive and the Extension will join Meadowlands Parkway on the north end and the Turnpike connections on the south end. From the Turnpike, Seaview Drive Extension will provide access to the Transfer Station and the proposed commercial development to be constructed as an integral part of the Transit facility.

Additionally, New County Road crosses tracks of Norfolk Southern Railroad at grade, and often, whenever freight carriers service the nearby Croxton Yard, the road is blocked for extended time periods by long lines of freight cars. Due to the growth expected in the area, it was agreed that the public interest, safety, and convenience would best be served by constructing a bridge to carry New County Road over the tracks.

SUMMARY

The many technical issues associated with this vast undertaking presented major challenges dealing with complex geotechnical/structural and environmental issues/problems. The above alone was significant itself, but the magnitude of improvements adjacent to active high-speed railroad further added to the difficulty of the project.
Difficulties with multi-agency involvement were overcome with early, proactive involvement and decision making. A “Partnering Program” was instituted to encourage all players to “buy-in” to the same goal of Project completion. The goals of the Owner (NJ Transit) were met due to the Engineer’s proactive role and performance for this complex project. The strategies developed in preparation of design documents and resolution of issues with the Railroads in the design stage were result oriented which saved costs and accelerated construction schedules. Additionally, vast amounts of planning, coordination and cooperation on both the public and private sides was necessary throughout the life of the Program for its success as well as that of the adjacent undertakings.

As the centerpiece of the North Jersey Commuter network, the Frank R. Lautenberg Rail Station at Secaucus Junction unifies a historically fragmented commuter rail network, providing an array of intra-state travel opportunities not possible today. The reduction of 15 minutes in travel time each way for North Jersey commuters along with those in Rockland and Orange County, NY, traveling to mid-town Manhattan provides a quality of life improvement that cannot be quantified. The project and its related improvements are expected to serve as a catalyst for economic development in Northern New Jersey. Future rail services on the West Shore Line and the New York, Susquehanna and Western Line can be integrated into this facility, but even more certain as a result of this Program is rail access to the Meadowlands Sports Complex in the near
future. With the completion of the Program, the additional train capacity and flexibility of the expanded railroad provides greater service to the public.
SECAUCUS TRANSFER PROGRAM CONSTRUCTION CONTRACTS

To expedite and facilitate construction, the work was broken into 9 Construction Contracts:

- GC-01 - Earthwork and Construction Access Roads,
- GC-02 - 138kv Relocation off-site,
- GC-03 - Foundations for 2 new Outer Tracks and Station,
- GC-04 - Superstructure for Outer Tracks and Station,
- GC-05 –Wetland Mitigation (eliminated with payment to Mitigation Bank),
- GC-06 – Station Finishes and Interior Bridges,
- GC-07 – New County Road Grade Separation and Station Access Roads,
- GC-08 – Main-Bergen Connection and Main-Line Improvements, and
- GC-09 – Station Signage Program.

The program began with a contract to place earthwork (including surcharging organic soils), and to construct access roads. Timber trestles supported on piles were needed over ponds and wetlands, while geotextile matting was used over organic soils. The second Contract relocated the NEC 138 KV power lines (redundant system atop the NEC Catenary structures) off-site to facilitate future foundation work. The new NEC eastbound and westbound track, viaduct/bridges were built parallel to and outside the existing NEC under a Foundation Contract and a Superstructure Contract. Additionally, foundation and structural steel framing for the Station and outer NEC platforms was performed under these contracts. Subsequent to the completion of the Superstructure Contract and after the transfer of all rail traffic to the newly constructed outer tracks, a final Interior Bridge Contract was awarded to demolish and reconstruct the existing NEC tracks and bridges between the new outer tracks. This contract also included all of the Station Finishes, along with an NEC center platform and 2 platforms on the NJT Main Line. The Main-Bergen Connection relocated the 2-track NJT Bergen County Line onto the NJT Main Line corridor to create a 4-track, 2-platform railroad to facilitate station transfers and free the BCL ROW for future roadway access. Accordingly, a grade separation of New County Road over the new 4-track Main Line was constructed, along with Station Access and drop-off roadways. The final contract was comprised of over 1,000 Station Signs. Additionally, 3 procurement contracts were performed to fabricate high-speed turnouts. All railroad track, catenary and power distribution work was designed under this program and performed by multiple AMTRAK and NJ Transit Force Account Contracts.
SECAUCUS TRANSFER PROGRAM – CONSTRUCTION FACTS & FIGURES

• Phase A. Northeast Corridor Modifications and Expansion
  — 10,000 LF of 1-track Viaduct supported on 2-4'dia Caissons or 10-18" Conc. filled Pipe Piles to rock
  — Viaduct superstructure comprised of 4 prestressed box beams
  — 3 reinforced conc. retaining walls totaling 2000 LF and 20' average height; supported on 18" pipe piles to rock
  — 200 caissons, 1500 pipe piles, and 5,000 H-piles installed
  — 8000 cy concrete in substructure (bent caps, pier columns and caps)
  — 15,000 cy concrete in structures (footings, retaining walls)
  — Over 20,000 LF track and 19 high speed turnouts (including 6 # 26.5 T.O. with movable point frogs) and over 11,000 prestressed concrete railroad ties
  — approx 3 mil # rebar
  — 3,000 LF pile-supported timber trestle access roads, ± 30’ wide
  — 500,000 CY Embankment/Preload Fill

• Phase B. Station Foundations & Platforms
  — Platforms - Northeast Corridor 3 @ 1200 LF, NJT Main Line 2 @ 760 LF
  — 3000 cy concrete for grade beams
  — 1000 cy concrete for pile caps
  — 1400 cy concrete for caisson caps
  — 300 caissons to rock (some with rock sockets) - 200 6'dia and 100 3’ dia.
  — Approx. 300 12” pipe piles to rock

• Phase C. Main-Bergen Connection and Main Line Improvements
  — 2400 LF of 2-track Viaduct supported on 12-18" Conc. filled Pipe Piles to rock – approx. 1000 pipe piles
  — Viaduct superstructure comprised of 8 prestressed box beams
  — 130,000 # rebar
  — 930 cy concrete in substructure
  — 490 cy concrete in superstructure
  — 160 cy concrete approach slabs
  — Over 50,000 LF track and 20 turnouts (# 20 T.O. with tangential geometry), and over 25,000 prestressed concrete railroad ties

• Phase D. New County Road Grade Separation
  — 2,000 LF of wall (mechanically stabilized earth faced with precast modular wall panels)
  — 210,000# rebar
  — 2500 cy concrete
  — 6000 LF reinforced conc. culvert pipe (12” to 24”)