



Aviation / Terminal

Engineering Qualifications

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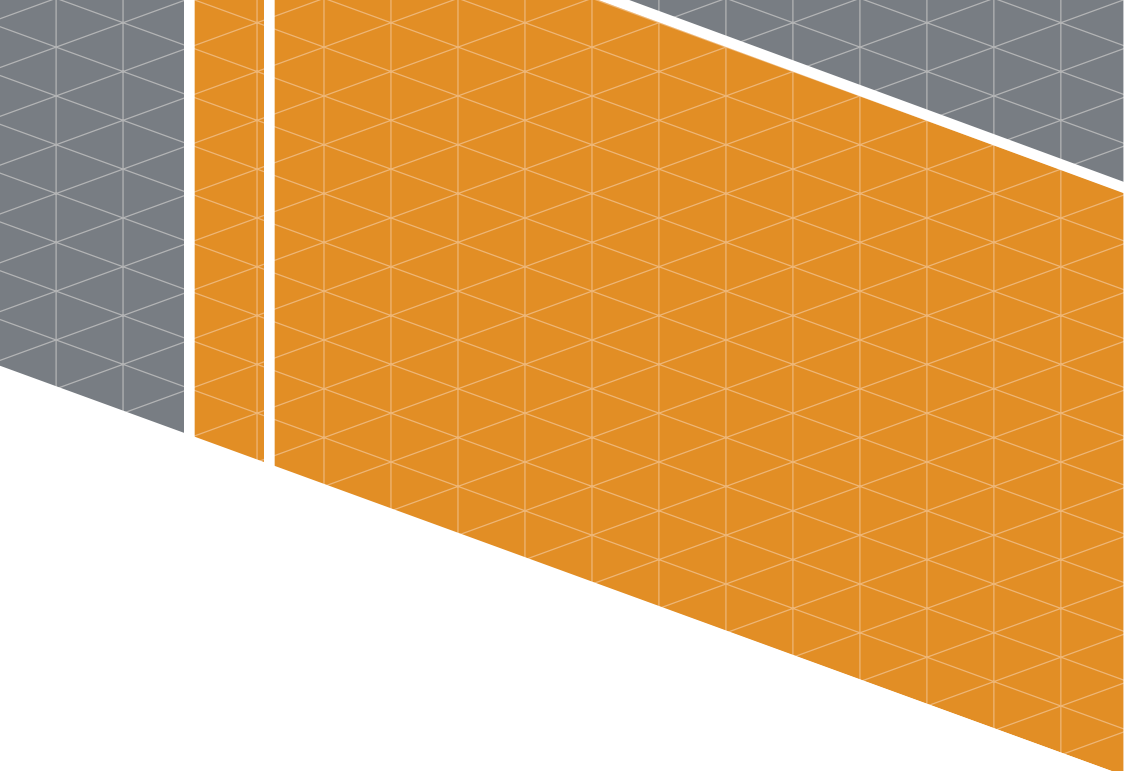
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Arora Engineers

At Arora Engineers (Arora), we believe infrastructure needs to do far more than provide a seamless, safe, sustainable and comfortable environment. Our goal is to maximize its role, impact and value through highly intelligent solutions that not only meet operational needs, but forward business objectives.

We meet the evolving needs of the world's most critical industries – aviation, transportation and education – through more intelligent, sustainable and connected infrastructure solutions that maximize value for our clients and partners.

Expertise

Since 1986 we have held ourselves to rethinking the role of the traditional MEP firm. As a result, we've evolved our practice to emphasize the technology and processes that connect systems infrastructure, improve operations and longevity and make life safer and easier for those who use it.

Arora specializes in providing engineering services tailored for clients in aviation, transportation, education, government and commercial sectors and has developed a unique understanding of the challenges and opportunities facing these critical industries.

Services

SPECIAL SYSTEMS / TECHNOLOGY

- + Mass Notification & Public Address
- + WiFi systems
- + Voice/data systems
- + Network architecture
- + Data centers
- + MDF/IDF room layouts
- + Network design via fiber or copper backbone
- + Plant cabling systems
- + Fiber optic and copper structured cabling systems
- + Communications system design
- + CCTV/MATV/CATV systems
- + Access control
- + Duress systems
- + Perimeter intrusion detection
- + Risk and needs assessments
- + Video walls
- + Security operations and procedures evaluation
- + Passenger/customer information display systems
- + Signage systems/Electronic video information display systems (EVIDS)
- + Software and equipment evaluation and recommendations
- + FIDS/BIDS/GIDS/CUPPS/SUPPS
- + Multi-lingual/International traveler

ELECTRICAL

- + Low and medium voltage power distribution
 - + Emergency and standby power systems
 - + Lighting design and photometrics
 - + Substation/switchgear
 - + Grounding and lightning protection
 - + Single-line diagrams
 - + Short circuit & coordination studies
 - + Power and lighting equipment selection and specifications
 - + Motor control centers
 - + Electrical equipment sizing
 - + Energy efficient systems
 - + Electrical code analysis
 - + Electrical plan review and master plan development
-

AIRFIELD ELECTRICAL

- + Airfield Lighting and Signage
 - + Approach Lighting Systems
 - + Instrument Landing Systems
 - + Navigational Aids
 - + Airfield Lighting and Control Systems
 - + Runway Incursion Mitigation
 - + Pavement Surface Sensor Systems
-

HVAC / PLUMBING

- + Sustainable/Green Building design
 - + HVAC
 - + Central plant design
 - + Underfloor Air Systems design
 - + Constant and variable air volume systems
 - + Radiant heating systems
 - + Geothermal system design
 - + Building automation and digital controls
 - + Domestic water systems
 - + Storm and sanitary system design
 - + Fuel system design
 - + Lifecycle Costing, Energy Analyses
-

FIRE PROTECTION AND LIFE SAFETY

- + Fire alarm and detection system design
 - + Standpipes and water-based sprinkler system design
 - + Foam systems and special hazard suppression design
 - + Fire pumps and fire protection water supply system design
 - + Smoke management
 - + Code analysis and consulting
 - + Plan review
 - + Due diligence reports
 - + Performance based analysis
 - + Risk/hazard assessment
 - + Site conditions survey
-

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

- + Database setup and implementation plans
 - + CAD to GIS conversion plans
 - + FAA Airport GIS program compliance
 - + Legacy data access integration
 - + Web-based GIS portal development
 - + Asset and utility data management
 - + Field inspection and inventory
 - + GPS data capture and attribution
-

PROGRAM MANAGEMENT

- + Project management
 - + Procurement coordination
 - + Information management
 - + All-inclusive project control
 - + Runway Incursion Mitigation
 - + Pavement Surface Sensor Systems
 - + Airfield Lighting Vaults and Power Distribution
 - + Sustainable Solutions
 - + Construction Safety and Phasing
-

CONSTRUCTION MANAGEMENT & INSPECTION

- + Project administration
- + Master systems integrator
- + Daily inspection
- + Project documentation
- + Submittal review/tenant permit reviews
- + Design support
- + Constructability reviews
- + Value engineering
- + Runway Incursion Mitigation
- + Airfield Lighting Vaults and Power Distribution
- + Pavement Surface Sensor Systems
- + Construction Safety and Phasing



PROJECT DETAILS

Client

Navin Natarajan
AECOM
125 Broad Street, 15th Floor
New York, NY 10004
navin.natarajan@aecom.com
(212) 377-8544

Construction

\$344,000,000

Project Start

2018

Project Completion

2022

Highlights

- + Part of a \$13 Billion campaign to modernize JFK airport and increase passenger capacity.
- + MEP, Fire Life Safety, and Special Systems engineering services
- + Additional 70,400 SF for T8
- + Refurbishing 57,500 SF at T8
- + Addition of five gates
- + Baggage system upgrades

AMERICAN AIRLINES

TERMINAL 8 CAPACITY ENHANCEMENT

John F. Kennedy International Airport (JFK), Queens, NY

Arora Engineers (Arora) was selected to be part of the team responsible for the renovation and enhancement of Terminal 8 at John F. Kennedy International Airport (JFK). Arora is a member of the construction team and served as a subconsultant to AECOM, who, along with Merchant Aviation, led design services with Holt Construction serving as the construction manager. The project scope included 70,400 SF of added space, including 33,000 SF of public space and 57,500 SF of refurbished existing space. Terminal amenities included five gates, new premium lounges, improved baggage systems, and upgraded check-in areas and concessions. The project included five new wide-body gates to allow for more flights and four nearby on-airfield plane parking and unloading areas to accommodate the added flights.

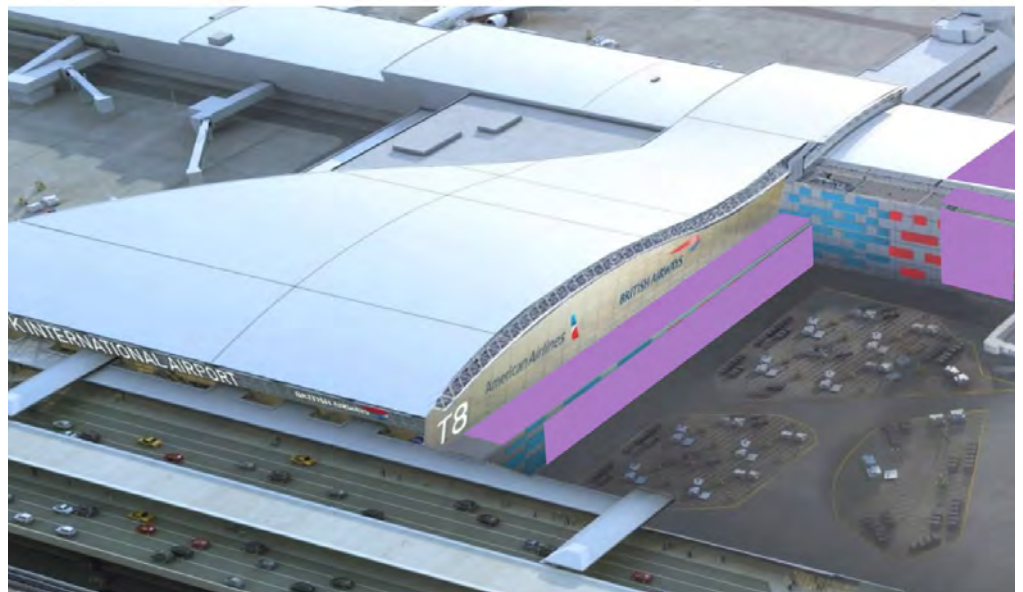
The expansion of Terminal 8 was part of JFK's \$13-billion modernization program, aimed at transforming the airport into an ultramodern, global hub with new and restructured terminals adding four million SF and increasing the airport's capacity by 15 million passengers annually.

Arora provided lead mechanical, electrical, plumbing, fire life safety, and special systems engineering design services from 30% conceptual design through 100% implementation document phase, as well as construction support services for the duration of the project.

Scope of work included:

Arora provided professional design and engineering services as the lead engineer for the following disciplines:

- + Mechanical, electrical, plumbing (MEP)



Rendering Via Gov. Andrew Cuomo's Office

**AMERICAN AIRLINES
TERMINAL
8 CAPACITY
ENHANCEMENT**

**John F. Kennedy
International Airport
(JFK), Queens, NY**

- + Fire life safety, including
 - + Fire suppression
 - + Fire alarm
- + Special systems – (less security and surveillance)
- + Baggage handling system (BHS) existing-conditions survey
- + Apron lighting
- + Head house extension (30ft) on arrival and interstitial levels
- + Extension of the concourse adjacent to gate 14 & 16 to the East, a total of 60 ft (Zone 1)
- + Extension to gate 18/20 on ramp, interstitial and boarding level
- + Buildout of space on the fourth level of the terminal, including relocation of American Airlines staff
- + Development of shell space of 22,300 SF for a future lounge construction on the fourth level
- + Installation of three new 777-300 capable hardstands of the existing parcel M
- + Separate gates 14 & 16 common boarding to allow for parallel boarding and deplaning of the two gates
- + Addition of line zero of security screening
- + Reinstallation and modification of screening subsystem (CTX9800)
- + Reconfiguration of the existing premium service check-in
- + Up-gauge gate 31 to a 777-300 capable gate
- + Up-gauge gate 32 and 46 to a 777-200 capable gate
- + Installation of new CBR area
- + Addition of a new international claim devices

PROJECT DETAILS

Client

Shane Stockman
Director of Information
Technology
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Asheville, NC 28732
sstockman@flyavl.com
(828) 654-3240

Construction

\$150,000,000

Project Start

2019

Project Completion

2022

Highlights

- + Providing special systems, fire protection engineering, and code consulting services for the AVL Phase 2 Terminal Modernization Project.
- + Special systems included structured cabling systems, EVIDS, public address/ audio paging systems, etc.
- + Fire protection included wet and dry water-based sprinkler and standpipe systems.
- + Code consulting included occupancy classification, egress coordination, definition of fire/life safety strategies, etc.

ASHEVILLE REGIONAL AIRPORT AUTHORITY

AVL PHASE 2 TERMINAL MODERNIZATION

Asheville Regional Airport, Asheville, NC

Arora Engineers (Arora) was selected as part of the team responsible for the expansion and modernization of the Asheville Regional Airport Authority's (AVL) existing single story, seven-gate terminal building to a two story, 12-gate terminal building. Arora served as a subconsultant to Gresham Smith, a member of the design team for this Construction Manager @ Risk (CM@R) delivery project. The project included elements to enhance the terminal for future growth that AVL expects over the next 20 years.

The project also included a new second-level security screening checkpoint to allow for future growth and adaptability to evolving security needs, a modernization and resizing of the ticketing lobby to accommodate multiple users and growth, enhanced curbside amenities including dynamic signing elements, and a new baggage-claim hall sized to meet the intended fleet mix and provide the necessary airline and airport support space, as well as a central energy plant located on site to support the growing infrastructure needs while providing expandability.

Arora led the special systems and fire protection engineering design and provided code consulting services associated with the AVL Phase 2 Terminal Modernization Project.

Scope of work included:

The team began by completing a basis of design report (BOD), which documented and analyzed the connections to the existing terminal building systems and tower which sits atop the terminal. The BOD analysis documented systems in need of upgrades, expansion, replacement and/or relocation. The data was used for conceptual design and phasing to accurately determine how to keep systems active during construction. Arora's design services included:



Rendering Courtesy of Gresham Smith

ASHEVILLE
REGIONAL AIRPORT
AUTHORITY

AVL PHASE
2 TERMINAL
MODERNIZATION

Ashville Regional
Airport, Asheville, NC

Special Systems-

- + **Structured Cabling System-** The terminal structured cabling system (SCS) supported all networked systems. The SCS was the backbone of all communications. Arora coordinated, documented, and designed all systems' structured cabling requirements, including mechanical, electrical, and plumbing (MEP) systems, tenants' systems, TSA, CBP, ACS, CCTV, EVIDS, CUPPS, etc. Along with structured cabling, Arora provided all infrastructure designs for backbone communication cables—including cable tray and conduits—and coordinated closely with other building systems for routing including structural, mechanical, and baggage systems. Very closely related to the SCS are the required telecommunications rooms (TR's) for termination of passive infrastructure and origination of active networking components as well as space for ACS and other systems. Arora worked closely with building architects to appropriately size TR's based on areas served and systems supported. Arora was responsible for all design and layout of cabinets, racks, wall fields, cable tray, and telecommunications grounding systems.
- + **Electronic Video Information Displays (EVIDS)-** EVIDS included traditional FIDS, BIDS, GIDS, RIDS, TIDS, visual paging, etc.
- + **Public Address/Audio Paging Systems-** Speaker selections and locations coordinated with architect, ambient noise sensing system, intelligibility calculations for all areas, paging station requirements, mass notification requirements, backup power requirements for PA system components, network device requirements, paging system zoning, integration with common use system for automated gate boarding, integration with EVIDS and visual paging systems for emergency notification and mass notification, wiring diagrams, elevations, details.
- + **Access Control and CCTV-** Arora provided designs for security technology and infrastructure based on regulatory need and thorough risk assessment. CCTV cameras were designed using the latest in IP camera technology, connected via the SCS to secure telecommunications rooms and storage network. Arora selected CCTV camera specifications based on the camera's location, height and view. The design enabled different terminal stakeholders to access video associated with their roles in the terminal.

CCTV cameras were designed as a part of the baggage handling system (BHS) as well as the airport's CCTV system. Arora coordinated with the BHS designer on areas of potential jams and designing CCTV cameras for those areas as well as monitoring of screening devices. CCTV camera views were made available in the BHS system operation office as well as TSA screening rooms. All baggage handling systems which cross from public space to secure or sterile space were controlled and monitored by access/security surveillance system (SA/SS).

Access control required the design of access control doors, equipment, infrastructure, management software, integration with Fire, EVIDS, CCTV and BHS. Arora worked with the architect to identify and coordinate all access control door hardware.

Arora provided design services for all required ACS and CCTV devices required for the new checkpoints inclusive of duress systems.

- + **Wi-Fi, DAS-** Arora included the design of Wi-Fi and DAS systems.
- + **Passenger Processing Systems-** Arora provided special systems design and engineering for common use systems or traditional passing reprocessing systems.

ASHEVILLE REGIONAL AIRPORT AUTHORITY

AVL PHASE 2 TERMINAL MODERNIZATION

Ashville Regional
Airport, Richmond, VA

Arora worked closely with the architect regarding common use equipment selection, locations functionality, and programming. Arora coordinated all ticketing and gate use equipment power requirements with other consultants, as well as millwork coordination. Arora specified integration requirements between the common use system, MUFIDS, baggage reconciliation systems and public address/visual paging/mass notification systems. The design and engineering included all required specifications and details as well as structured cabling requirements.

Fire Protection- The scope of work included the design of various fire protection systems to provide a fully sprinklered building as required by code. These systems included standard wet and dry water-based sprinkler and standpipe systems as well as deluge sprinkler, pre-action sprinkler, and gaseous suppression systems for high value or high challenge assets. The fire protection systems were designed in accordance with the applicable building codes and NFPA standards. A water-based fire suppression system was supplied by the existing water infrastructure. However, hydraulic calculations were performed to verify that the existing capacity met the proposed demand. The alteration of existing systems accounted for construction phasing to ensure fire-protection-occupied areas remained operational.

Code Consulting- Arora's in-house design professionals supported the team with code-consulting services. These services included occupancy classification, egress coordination, definition of fire/life safety strategies, and the analysis of codes and design features.



Rendering Courtesy of Gresham Smith

PROJECT DETAILS

Client

AECOM
Terry Rookard
Vice President/Principal
Architect
1 Federal Street, 8th Fl
Boston, MA 02110
terry.rookard@aecom.com
(617) 371-4493

Construction

\$185,000,000

Project Start

2018

Project Completion

Ongoing

Highlights

- + Provided professional services for the planning, design, engineering and construction oversight of a new terminal at BDL.

CONNECTICUT AIRPORT AUTHORITY

TERMINAL DEVELOPMENT PROGRAM

Bradley International Airport, Windsor Locks, CT

Arora Engineers (Arora) provided professional engineering services to AECOM for the Terminal Development Program at Bradley International Airport, which is the state's largest airport serving the capitol of Connecticut and the surrounding southern New England region. The program involved planning, design, engineering, architectural and construction oversight services related to the construction of a new terminal, and improvements and expansions to existing facilities.

Scope of work included:

The construction of this new terminal will be completed in phases, and Arora supported the team in reviewing, evaluating, and suggesting technical approaches to further define the terminal development concepts, informed by the recently completed Bradley Airport Master Plan. Project responsibilities included:

- + Scope, schedule and price development associated with the various phases of the overall project.
- + Terminal programming, including airside and landside components, and phasing plans.
- + Completion of an air traffic forecast update/
- + Design elements, including relocation of the current Federal Inspection Services (FIS) facility, inline bag screening equipment, airport concessions, passenger circulation improvements, and security checkpoint enhancements.



Rendering Courtesy of AECOM

In-Line Checked Baggage Inspection System (CBIS) Task:

Under this agreement, Arora provided engineering services for the design of a new In-Line Checked Baggage Inspection System (CBIS) utilizing explosive detection systems (EDS) for Terminal A at Bradley International Airport (BDL). The system will transport the nearly two million checked bags BDL screens each year along a mile-long network of conveyor belts to a new, 80,000 SF building for security screening. This facility will eliminate baggage screening from the terminal lobby, freeing up space for up to 16 new airline ticket counters.

The initial phases of work included reviewing and commenting on the 30% package developed and submitted to the TSA in 2013. The 30% package envisioned replacing all existing “in-lobby” CT80 stand-alone screening machines with an in-line CBIS/CBRA located in a new airside facility. The review was accomplished with ILDT participation to validate/verify the overall system capacity requirements, location, and other operational requirements.

Upon completion of this review, the team provided complete design and bid phase services for the new CBIS in accordance with the OTA and based upon the Transportation Security Administration Planning Guidelines and Design Standards (PGDS) v6.0, for all phases of design from schematic through final design and construction phase services.

Overall Design Phase services for the Baggage Handling Checked Baggage Inspections System included:

- + Development of the BHS/CBIS plans and sections to provide the content and the level of detail to the TSA for final review and approval to proceed to construction.
- + Development of conveyor maintenance catwalk and access drawings, BHS structural support and loading details, user interface details, control system schematics and details, signage details.
- + Conveyor manifest (approximate conveyor lengths and belt speeds).
- + BHS/CBIS Description of Operation.
- + Estimate of BHS/CBIS power requirements.
- + Assistance with completion of project/phasing schedule.
- + Assistance with completion of Configuration Management Plan.
- + Assistance with completion of Contingency Plan.
- + Assistance with preparation of responses to review comments received in previous phase.
- + Specifications for the BHS/CBIS.
- + Preparation of 100% Construction Documents suitable for public bidding, including frontend specifications and submit for CAA review.

PROJECT DETAILS

Client

Gresham Smith
Jim Harding
1400 Nashville City Center,
511 Union Street
Nashville, TN 37219-1733
Jim_Harding@gspnet.com
615-770-8292

Construction

\$200,000,000

Project Start

2016

Project Completion

2018

Highlights

- + Providing the designs and specifications for the digital display elements of the Concourse A expansion and renovation.
- + Participating in the software selection panel.

CITY OF CHARLOTTE, AVIATION DEPARTMENT

CONCOURSE A EXPANSION AND RENOVATION

Charlotte Douglas International Airport (CLT), Charlotte, NC

Part of the continued growth of Charlotte Douglas International Airport (CLT), the 229,807 square foot expansion and renovation of Concourse A was completed in the summer of 2018. This project focused on the construction of nine gates north of Concourse A, which replaced several existing gates and accommodated increased air service. A new concrete ramp and new taxi lanes was also constructed to operate the new gates.

Arora Engineers (Arora) was tasked with providing electronic video information display systems (EVIDS) and special systems engineering services for the expansion and renovation.

Scope of work included:

The project, led by Gresham, Smith and Partners (GS&P), included the development of contract documents and bid packages for signage and digital displays required in the areas of new construction. Arora's scope of work included:

- + Providing the designs and specifications for the digital display elements.
- + Providing the location details, hardware specifications, and associated infrastructure requirements such as wiring, electrical loads, connections/attachment details, and associated information.
- + Participating in the software selection panel along with CLT stakeholders.
- + Assisting CLT with developing evaluation criteria and a ranking matrix to ensure the selection of the best software solution.

The digital display elements to be designed included the following:

- + Interior gate identification signs (static and digital)
- + "You are here" dynamic directories (digital)
- + Flight Information Displays (FIDS)
- + Optional video wall displays at jetway entrance gates



PROJECT DETAILS

Client

HDR, Inc.
Ruth Krieger, AIA, LEED AP
500 Seventh Avenue
New York, NY 10018
212-542-6042
ruth.krieger@hdrinc.com

Construction

\$46,000,000.00

Project Start

2020

Project Completion

Est. 2026

Highlights

- + Arora provided Mechanical, Plumbing, Electrical, Fire Life Safety, Fire Protection, and Special Systems (low voltage) Engineering services.
- + Improve passenger experience and customer service at the airport.
- + Design and construction documentation for the toilet room renovations

CITY OF PHILADELPHIA DIVISION OF AVIATION DESIGN SERVICES FOR PHL RESTROOM UPGRADES

Philadelphia International Airport (PHL), Philadelphia, PA

Arora Engineers (Arora), as a subconsultant to HDR, Inc., provided design services for the restroom renovations project at Philadelphia International Airport (PHL). Arora provided engineering design services for mechanical, plumbing, electrical, fire life safety, fire protection, and special systems (low voltage) engineering. The intent of the Restroom Renovation Program was to improve passenger experience and customer service at the airport by providing exceptional quality restrooms and related amenity facilities to the travelling public. Key planning and design factors were convenience of location, proximity to other airport facilities, travel distances, high-quality and durable finishes, ease of maintenance for building systems, and custodial operations.

The core restroom facilities included male and female washrooms and gender-neutral, companion-care washrooms. Ancillary functions included art displays, janitors' closets, storage, and other custodial function spaces. Related functions included service animal relief areas, lactation suites, quiet spaces (for meditation, reflection, prayer), device charging spaces and companion-care spaces incorporating amenities such as adult changing.

Design considerations included provisions of universal accessibility, passenger flow and circulation. The project was divided into three phases with about ten restrooms in each phase.

Scope of work included:

Arora provided design and construction documentation for the toilet room renovations, which included fixture and finish replacement with all plumbing fixtures remaining in place to full renovations consisting of relocation of some or all plumbing fixtures. Arora provided the following design services by discipline:

Mechanical – Arora provided engineering & design documentation to reconfigure the existing supply and exhaust ductwork assemblies to accommodate new plan and ceiling layouts. Arora verified whether existing HVAC/exhaust mechanical units would comply with current code requirements in the new configuration layout.



CITY OF
PHILADELPHIA
DIVISION OF
AVIATION

DESIGN SERVICES
FOR PHL RESTROOM
UPGRADES

Philadelphia
International Airport
(PHL), Philadelphia, PA

Electrical – Arora provided new electrical system upgrades within the areas of renovation to meet code and support this project's renovations and lighting layouts. This included new power and data outlets, lighting, and equipment support. In addition to the electrical design, services included design of new exterior building and site lighting.

Plumbing – Arora provided engineering and design documentation to reconfigure the existing domestic water supply, hot water supply, and sanitary and vent piping to the new plumbing fixtures. These include water closets, urinals, lavatory sinks, janitorial mop sinks, floor drains, and electric water coolers. All connections were made from/to the nearest viable source within five feet of the renovated toilet room.

Fire Alarm – Arora modified the existing fire alarm system as required to accommodate the room layouts and meet code requirements. Arora provided a coordinated layout of required devices, including smoke detectors, manual pull stations, building system interface modules, notification appliances, and remote annunciators.

Fire Protection – Arora modified the existing fire sprinkler system(s) as required to accommodate plan layout and meet code requirements. Arora coordinated relocation of the existing sprinkler heads and placement of new heads with the ceiling, lights, and diffusers.

Special Systems – Arora provided special systems designs for the relocation of any CCTV, public address speaker systems, and access control affected by the renovations and coordinated new device locations with the new plan layouts.

In addition, Arora provided engineering design and construction documentation for the creation of five new restroom clusters. Engineering addressed the cluster area defined by its footprint and the extension of utilities specific to the restroom use.

CHALLENGES AND SOLUTIONS: PHL has been serving Pennsylvania and the nation for over 80 years, and obtaining sufficient existing conditions information for the airport's timeless terminals proved challenging for the team.

The design teams overcame this challenge by performing extensive site surveys of each restroom area, including opening up ceiling tiles in over 70 restroom areas to find and record all systems affected, such as the water, power, conduits and fire protection panels serving each of these areas.

Phasing was another critical element of this project. To minimize interruptions to normal airport operations and prioritize passenger experience, Arora's team initially helped to track passenger flow and counts at each of PHL's restrooms to determine usage patterns. This data helped the team develop their phasing plans for these restroom renovations, which included night work and prioritization of day-time work on less-used restroom facilities.

These renovations also provided an opportunity to improve disease mitigation and energy efficiency. Code dictated that restroom air must be deposited outside the build, and in order to increase energy savings, Arora implemented flat plate energy recovery exchangers to reduce the energy needed to condition the fresh return air to the restrooms. To help mitigate the spread of disease, the team implemented bipolar ionization to clean the air and specified touchless accessories to ensure users a touch-free restroom experience.

PROJECT DETAILS

Client

HNTB Corporation
Thomas A. Defant, Jr., PMP
1650 Arch Street,
Philadelphia, PA 19103
215-568-6500
tdefant@HNTB.com

Construction

\$46,000,000

Project Start

2019

Project Completion

Est. 2026

Highlights

- + Arora provided construction phase services and overall project management
- + Improved passenger experience and customer service at the airport.

CITY OF PHILADELPHIA DIVISION OF AVIATION

PROJECT MANAGEMENT AND CONSTRUCTION INSPECTION FOR PHL RESTROOM UPGRADES I-IV

Philadelphia International Airport (PHL), Philadelphia, PA

Arora Engineers (Arora), as a subconsultant to HNTB, provided construction inspection and administration services for the restroom renovations project at Philadelphia International Airport (PHL), which involved the rehabilitation of over 30 sets of passenger-facing restrooms. The intent of the Restroom Renovation Program was to improve passenger experience and customer service at the airport by providing exceptional quality restrooms and related amenity facilities to the travelling public. Key planning and design factors were convenience of location, proximity to other airport facilities, travel distances, high quality and durable finishes, ease of maintenance for building systems, and custodial operations.

The core restroom facilities included male and female washrooms and gender-neutral, companion-care washrooms. Ancillary functions included art displays, janitors' closets, storage, and other custodial function spaces. Related functions included Service Animal relief areas, lactation suites, adult changing rooms, quiet spaces (for meditation, reflection, prayer), device charging spaces and companion-care spaces incorporating amenities such as adult changing.

The project was divided into three phases with about ten restrooms in each phase.



Scope of work included:

Serving as the airport's representative, Arora's onsite construction management team was responsible for providing inspection services for the mechanical, electrical, plumbing, fire alarm, fire protection and security systems. Arora's construction phase services included:

- + Overall project management support to the PM during planning, design, construction and closeout.
- + Design and construction review to verify and validate that all Division of Aviation (DOA) requirements and expectations were met.

**CITY OF
PHILADELPHIA
DIVISION OF
AVIATION**

**PROJECT
MANAGEMENT AND
CONSTRUCTION
INSPECTION FOR PHL
RESTROOM
UPGRADES I-IV**

**Philadelphia
International Airport
(PHL), Philadelphia, PA**

- + Provision of support during project bid opening, evaluation, and procurement processes.
- + Review of shop drawings to ensure compliance with project specifications and DOA security requirements.
- + Conducted project coordination meetings.
- + Prepared progress charts, construction schedules, and reports.
- + Processed RFI's and submittals, and provided engineering support.
- + Collection and validation of as-built drawings from the contractor.
- + Constructability – Improving connection points that help mount finishes more effectively.
- + Maintenance – change of grout and tile to minimize grout lines and build up.

LESSONS LEARNED:

- + Constructability – Change of sink types to minimize ponding of water and bacteria growth.
- + Constructability – Improved door hooks to decrease failure in long-term use.
- + Design – thorough site surveys to minimize field changes during construction.
- + Design – modified stall doors to decrease visibility and durability over long-term use.
- + Constructability – modified lighting and positioning of lights.
- + Maintenance – soap system upgrade and larger reservoir.
- + Maintenance – key core changes for ease of access for custodial and maintenance.
- + Maintenance – Connecting energy recovery units to building automation system.
- + Adapting to ADA compliance heights – sinks, water fountains, outlets, benches, and toilets.

PROJECT DETAILS

Client

Gresham, Smith & Partners
Altan Cekin, AIA, NCARB,
Principal
Two Harbour Place
302 Knights Run Avenue,
Suite 900
Tampa, FL 33602
altan_cekin@gspnet.com
(813) 769-8917

Construction

\$608,000,000

Fee

\$1,114,125
Task One: \$235,309
Task Two: \$741,740
Task Three: \$157,076
Task Four: \$9,000

Project Start

2016

Project Completion

Construction broke ground:
2019

West Side of TLE: 2022
Construction Completion:
Est. 2025

Highlights

- + Largest construction project in the airport's history
- + 366,000 SF terminal enhancement and expansion project
- + Arora is responsible for all special systems design and engineering

CITY OF CHARLOTTE, CHARLOTTE AVIATION DEPARTMENT

TERMINAL LOBBY EXPANSION

Charlotte Douglas International Airport, Charlotte, NC

Charlotte Douglas International Airport (CLT) is undergoing several critical improvements to its infrastructure as part of the \$3.1 billion Destination CLT capital investment program. This program is designed to meet the growing needs of CLT's 46 million annual customers. Destination CLT projects include increased terminal roadway capacity, new walk-ways, main terminal expansion, expanding concourses A, B, and C, and the addition of a fourth parallel runway.

Arora Engineers (Arora) is part of the design team tasked with expanding the existing terminal and lobby, which has been in use since 1982. This 366,000 SF expansion, encompassing a 175,000 SF addition, along with the renovation of 191,000 SF, significantly enhance the existing terminal interiors and extend the terminal area.

On the exterior, improvements include a new 146,000 SF canopy to cover the elevated roadway and curb to shield passengers. In addition, There is a new west end subterranean walkway, located on the Hourly Deck's first floor which provides a traffic-free, covered walking path from the Hourly Deck to the terminal. Terminal improvements include state-of-the-art ticket counters, original artwork, five additional concession spaces, expanded seating and charging stations, and a consolidation of the existing five security checkpoints into three larger checkpoints with automated screening lanes. This project also includes a new central energy plant and all associated low voltage and security systems.

Portions of the Terminal Lobby Expansion's (TLE) west side opened in the summer of 2022, providing approximately 90,000 SF of additional circulation space, access to the west subterranean walkway and a preview of the terminal's modern interior



Rendering courtesy of Gresham, Smith & Partners

**CITY OF CHARLOTTE,
CHARLOTTE
AVIATION
DEPARTMENT**

**TERMINAL LOBBY
EXPANSION**

**Charlotte Douglas
International Airport,
Charlotte, NC**

design replete with new, expansive windows, terrazzo flooring, bright blue tiles and architectural-detailed scalloped ceilings.



Image Courtesy of Charlotte Douglas International Airport

A unique challenge of this project was phasing. Specifically, a construction phase was proposed to make modifications to an existing access control intelligent controller or controllers location that would affect areas outside the phase's physical scope of work. Our design team worked to address this issue by designing permanent and temporary access-control measures and infrastructure that would limit downtime to acceptable durations and not affect ongoing operations. The project included several hundred access control points and CCTV cameras.

The additional space provides more room for check-in, baggage claim areas, redesigned security checkpoints with larger, more efficient configurations, and increased circulation space in the lobby. The project also includes bridges and tunnels for pedestrians, connecting the hourly deck and car rental agencies to the terminal so passengers can access them without crossing the road.

Scope of work included:

Arora was responsible for all special systems design and engineering services, including access control, CCTV, passenger processing systems, security checkpoint design, Electronic Video Information Display Systems (EVIDS), public address, ICT and structured cabling systems, Wi-Fi, and passenger information systems including passenger analytics. The CCTV security systems design included head-end upgrades and expansions to support new technology as well as modifications to the head-end monitoring hardware.

The terminal lobby expansion also included the design and construction of a new Central Energy Plant (CEP) serving CLT. Arora's scope included the special systems, telecom, security and CCTV for the new CEP including, but not limited to:

New Telecommunications Room/Closets – The telecommunications room is a dedicated and maintained telecommunications space absent of other energy plant electrical components or services except for electrical and other systems serving

**CITY OF CHARLOTTE,
CHARLOTTE
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DEPARTMENT
TERMINAL LOBBY
EXPANSION**

**Charlotte Douglas
International Airport,
Charlotte, NC**

this room. The CEP Telecommunications Room provided adequate space for information technology cable terminations (horizontal and backbone), active and passive communications equipment, cross-connection wiring and hardware, and any other materials or equipment associated with the CEP technology deployment. Arora included a design factor of 50% growth in the layout of the CEP Telecommunication Room.

Telecommunications Room Mechanical Systems - The CEP Telecommunications Room was designed to include HVAC service designed to dissipate the heat generated by electrically powered communications equipment supporting the airport's 24/7 operations. The temperature for the telecommunications room was in the range of 68 degrees F to 75 degrees F, and humidity was maintained between 40% and 55% relative humidity.

Telecommunications Room Fire Protection/Fire Alarm - The CEP Telecommunications Room was protected by a pre-action clean agent system. The fire protection system in the room was integrated with the HVAC system and UPS/Power source to disconnect service in the event of system activation. Wall linings were covered with two coats of fire-retardant white paint.

Universal Cabling Distribution System (UCDS) – Arora designed the UCDS, backbone cabling systems, fiber backbone, and horizontal cabling at the CEP which consisted of a passive cabling infrastructure that features copper cabling, fiber cabling, serial cabling, and other low voltage cabling. The UCDS incorporated the telecommunications room/closets as well as outside connectivity to the CLT TSO and external service providers such as AT&T. Support systems included:

- + Access control
- + CCTV
- + SCADA/MEP systems
- + Voice (VoIP, POTS)
- + Wi-Fi

Construction of the main terminal lobby expansion began in December 2019 and is expected to be completed in six progressive phases with an anticipated completion in 2025.



Rendering courtesy of Gresham, Smith & Partners

PROJECT DETAILS

Client

Delta Air Lines, Inc.
Susan Jenkins
General Manager,
Commercial Term C Project
75-20 Astoria Blvd.,
Suite 230
East Elmhurst, NY 11370
susan.jenkin01@delta.com
(929) 270-4541

Project Start

2022

Project Completion

Est. 2024

Highlights

- + LEED Commissioning Services (Fundamental + Enhanced)
- + Updated Commissioning (Cx) Plan for LEED related systems
- + Facilitated functional performance testing

DELTA AIR LINES, INC.

LGA CONOURSE F LEED CxA COMMISSIONING SERVICES

LaGuardia International Airport, Queens, NY

Arora Engineers (Arora), serving as the prime consultant, provided LEED Commissioning Services (Fundamental + Enhanced) for mechanical, electrical and plumbing (MEP) systems for Delta Airlines in LaGuardia International Airport (LGA)'s Concourse F.

Scope of work included:

The following systems were commissioned in accordance with the requirements of LEED 2009:

- + HVAC, including the Building Automation System (BAS)
- + Lighting control system
- + Plumbing hot water heaters

A Commissioning (Cx) Plan was developed by Arup, who is leading the LGA Delta Concourse F Expansion project and provided to Arora for implementation for continuity across systems. Arora then updated the Cx Plan for Concourse F for LEED related systems. The Commissioning (Cx) Plan addressed:

- + Roles and Responsibilities and interaction with the Operational Readiness Activation and Transition (ORAT) and Construction teams.
- + The Cx process for each individual system type and system interfaces/integration.
- + Development of pre-functional and functional test sheets and test plans.
- + Phasing and de-commissioning of existing systems.
- + Phasing and extension of new/existing systems.
- + Change management process.
- + Collection of and presentation of As-Built and O&M Data.
- + Training requirements and training plan.
- + Schedule, activities and duration.

Arora reviewed the MEP LEED systems, acting as the independent commissioning authority (CxA). Our team was responsible for reviewing the Concourse F equipment submittals applicable to systems being commissioned for compliance with the owner's project requirements (OPR) and basis of design (BOD) to ensure they met the Operation and Maintenance requirements.

Arora also facilitated functional performance testing. Periodic site were conducted to review system installation during the construction phase. The benefit of this approach is the ability to communicate expectations to the contractors early enough to minimize rework. These discussions at the beginning of construction resulted in more efficient work products and greatly reduced 'punch list' items for the duration of the project.

In addition, during site visits Arora randomly sampled the construction checklists as a means to verify that the installation of the systems and equipment met the OPR

**DELTA AIR LINES,
INC.**

**LGA CONCOURSE
F LEED CXA
COMMISSIONING
SERVICES**

**LaGuardia International
Airport, Queens, NY**

and proper documentation (record drawings) were being maintained. Arora also scheduled and led periodic commissioning process meetings.

Arora was responsible for the following Commissioning Services:

Systems Readiness / Pre-Functional Checks:

Contractor submittal information, manufacturer's technical information and O&M documentation as well as contract documents were used to develop the pre-functional test forms. Arora then utilized a random sampling procedure to verify the completed LEED MEP related checklists. Construction progress was tracked via construction checklists execution.

Functional Performance Testing:

Arora utilized the existing facility grid Functional Performance Testing (FPT) templates to prepare functional performance checklists to functionally test the LEED MEP related installed systems.

Arora then reviewed functional test samples of each commissioned system type to verify it was performing as specified and as required to meet the OPR/RPW. Arora simulated high demand, off-season and unoccupied conditions through control system manipulation to verify proper system response and coordinated control, including operating and safety control functions.

Integrated System Testing:

Arora supported ARUP's integrated system testing of each LEED MEP related commissioned system type to verify it is performing as specified and as required to meet the OPR/RPW.

Commissioning Issues Log:

Arora developed and maintained a commissioning issues log for LEED MEP related systems where deviations from the OPR/RPW and design documents were identified and documented their subsequent resolution. Arora assessed the importance of the issues and estimated the value of their correction in terms of environmental impact, improved health, safety and comfort, energy consumption, operating and maintenance cost and the ability of the facility to support its mission.

Summary Commissioning Report:

Arora provided the LEED related elements for a final report which included the written records of the commissioning work, including:

- + Executive summary of the process and the results of the commissioning program.
- + A history of any systems deficiencies identified and how they were resolved including any outstanding issues.
- + System performance test results and evaluation.
- + A summary of the O&M documentation and training processes

Operation and Maintenance Manuals:

Arora ensured that the owners and operations personnel were involved throughout the commissioning process so that Delta's maintenance and operations staff were already familiar with the systems which helps the buildings to be run more efficiently from day one of operation. Arora reviewed and checked the applicable O&M Manuals for completeness and confirmed that they match the installed and commissioned systems.

PROJECT DETAILS

Client

EXP US Services, Inc.
Stephen Elrod
205 N. Michigan Avenue
Chicago, IL 60601
Stephen.Elrod@exp.com
312-606-7421

Construction

\$4,207,830

Project Start

2018

Project Completion

2020

Highlights

- + Providing selective modifications and extensions of the existing base building systems, including fire protection, fire alarm, security, communications, pave, plumbing, HVAC, electrical and limited structural work, as well as construction administration.
- + Tasks included drawings and specifications, project communications, field investigations, meetings, responding to RFI's, and preparation of field reports.

CITIES OF DALLAS AND FT. WORTH

DFW DO #18 – TERMINAL D ACCESS CONTROL OFFICE RELOCATION

Dallas/Fort Worth International Airport, DFW Airport, TX

Dallas/Fort Worth International Airport (DFW) was in the process of an interior renovation of approximately 18,300 SF of shell-space on the landside of the concourse level of Terminal B, for the Access Control Office (ACO) relocation from Terminal D (6,700 square feet). The space included expanded training/testing stations (including driving simulators), queuing and waiting areas, larger conference rooms, a communications room, a break room, and additional offices for new employees.

Scope of work included:

Arora Engineers (Arora) provided engineering design and construction administration services for the ACO relocation. The work included selective modifications and extensions of the existing base building systems, including fire protection, fire alarm, security, communications, pave, plumbing, HVAC, electrical and limited structural work. Arora's scope of work included:

- + Drawings and Specifications: Preparing final construction drawings and specifications based on the final 35% design submittal and associated reviewed comments. Continuing with the preparation of 70%, 100%, Issue for Bid (IFB), and Issue for Construction (IFC) submittals.
- + Project Communications: Coordinating project requirements with EXP, sub consultants, DFW stakeholders, and tenants during the design phases.
- + Field Investigations: Conducting field observations of existing mechanical and plumbing systems, site, and facility existing conditions for verification of existing project record documents to provide final engineering design documents.
- + Meetings: Providing a minimum of one representative to attend 70%, 100%, Issued for Bid design review meetings (three), Pre-Bid conference (one), and participating



CITIES OF DALLAS AND FT. WORTH

DFW DO #18 – TERMINAL D ACCESS CONTROL OFFICE RELOCATION

Dallas/Fort Worth
International Airport,
DFW Airport, TX

in bi-weekly progress meetings (four via teleconference) during the 70% and 100% design phases of the project.

- + Construction Administration: Construction phases services included review and response to RFI's, site visits, preparation of field reports, and shop drawing review.

The AOC officially opened in May of 2020.



PROJECT DETAILS

Client

Bart Jacobson
Siemens Smart Infrastructure
8066 Flint Street
Lenexa, KS 66214
913-208-0470
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Construction

\$1,500,000,000.00

Project Start

2020

Project Completion

2021

Highlights

- + Arora provided engineering design services (special systems & BIM) for the Kansas City International Airport (KCI) MCI Airport Terminal Modernization Project.
- + Project consists of a one million square foot terminal facility.
- + Arora's scope specifically related to the program's new vertical structures including the new single terminal and parking at KCI project.

KANSAS CITY AVIATION DEPARTMENT

AIRPORT TERMINAL MODERNIZATION

Kansas City International Airport, Kansas City, MO

Arora Engineers (Arora), as a subconsultant to Siemens, provided engineering design services (special systems & BIM) for the Kansas City International Airport (KCI) Airport Terminal Modernization Project. The new single terminal and parking at KCI project consisted of a one million square foot terminal facility including curbside, ticketing lobby, TSA compliant security screening checkpoint, TSA compliant in-line checked baggage inspection system and associated support areas, baggage claim areas, baggage make-up area, and associated support functions. The terminal included two concourses attached by a 634-foot connection with moving walkways above and baggage handling systems below. Officials opened 18 security lanes to service the 39-gate facility, which replaced the airport's current configuration with gates spread across separate terminals.

The new terminal was the largest single infrastructure project in Kansas City history. The facility included secure concourses providing concessions and customer amenities. The facility initially supported 39 aircraft gates, but facility systems were designed to ultimately support 42 gates. The new single terminal project promised to improve the passenger experience, particularly for those making connections in Kansas City. It included dozens of retail and restaurant options beyond security checkpoints. It also doubled the number of restroom facilities available with 120 toilets spread throughout the terminal. The \$1.5 billion new terminal at Kansas City International Airport remained on schedule and on budget.

Scope of work included:

Arora's scope specifically related to the program's new vertical structures, including the new single terminal and parking at KCI project. Arora provided special systems engineering services to the CWC JV Team as a subconsultant to Siemens for the Systems Integrator role.



**KANSAS CITY
AVIATION
DEPARTMENT**

**AIRPORT TERMINAL
MODERNIZATION**

**Kansas City
International Airport
(KCI), Kansas City, MO**

Arora's special systems services included the following systems:

- + Access control system (ACS)
- + Video Surveillance System (VSS)
- + Public Safety Radio Distributed Antenna System (DAS) and Wireless Access Points (WAP or WiFi)
- + Converged communications network
- + Voice Over Internet Protocol (VOIP) telephone system
- + Audio Visual (AV) systems
- + Information Display System (IDS)
- + Visual paging
- + IPTV
- + Common Use System (CUS)
- + Transportation Security Administration (TSA) and Customs and Border Protection (CBP) IDS/VSS
- + BIM and Maximo ongoing support

Arora also provided a TRAX® SmartRestroom solution for Kansas City International Airport. The airport used this system for 16 restrooms utilizing TRAX Smart Restroom Technology.

- + The TRAX® Smart Restroom Solution is a cloud-hosted solution that included the following feature-sets:
- + Custodial cleaning activity data collected by the TRAX® iOS mobile application
- + TRAX® Smart Restroom Portal with business intelligence dashboards and real time reporting (web-based)
- + Passenger thermal throughput system with real time alerts and reporting with LTE Technology
- + Custodial staff mobile application with IOS Devices with LTE Technology

IN THE NEWS:

[New Kansas City International terminal reaches halfway point | The Kansas City Star \(ampproject.org\)](#)

[Kansas City Preaches Flexibility, Adaptability As NewKCI Rises – AirlineGeeks.com](#)

PROJECT DETAILS

Client

Gensler
Julius Bhang,
Design Realization Lead
500 South Figueroa Street
Los Angeles, CA 90071
julius_bhang@gensler.com
(213) 243-8724

Project Start

2016

Project Completion

2021

Highlights

- + Special systems engineering services on an on-call basis
- + Typical projects included improvements at LAX and VNY, including those that were part of LAWA's overall Capital Improvement Program (CIP)

LOS ANGELES WORLD AIRPORTS

ON-CALL FOR ARCHITECTURAL DESIGN SERVICES

Los Angeles International Airport, Los Angeles, CA

Arora Engineers (Arora) was tasked with providing special systems engineering services as part of an on-call contract for architectural design services for Los Angeles World Airports. The contract covered architectural design and engineering services for various improvement projects at Los Angeles International Airport and Van Nuys Airport.

Arora was responsible for all special systems engineering including voice and data communications, network design, fiber optics and copper structured cabling systems, security, access control, intrusion detection, CCTV systems, public address, and digital signage.

Typical improvement projects to be provided under this contract included but were not limited to the following: interior/ exterior fit and finish, signage and way finding, curbside improvements, Americans with Disabilities Act (ADA) upgrades, restroom replacement and upgrades, existing condition surveys and assessments, evaluation of various airline proposed projects, TSA passenger checkpoint upgrades, in-line baggage screening, US Customs and Border Protection facility upgrades, new telecom rooms and infrastructure, and building-related enabling services for various Landside Access Modernization Program (LAMP) projects and to support LAWA's modernization and the Capital Improvement Program (CIP).



PROJECT DETAILS

Client

Massachusetts Port Authority
Greg Etteridge, Senior Project
Manager
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200S, East Boston, MA
02128
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Construction

Est. \$800-900 Million

Project Start

2017

Project Completion

Est. 2025

Highlights

- + Analysis and code review
- + Detailed design of all MEP, fire alarm systems
- + Prepared initial space planning exercises with architects for planning purposes.

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International Airport (BOS), Boston, MA

Arora Engineers (Arora) was selected as part of the team to provide professional engineering services for the \$800-900M modernization of Terminal E to efficiently accommodate current and projected international operations and passengers. The Terminal E Modernization Project extended the existing concourse, terminal core, and terminal roadway frontages within the airport's existing footprint. Massport's vision for Terminal E was to create a modern, iconic international passenger terminal with an emphasis on enhanced passenger experience and operational flexibility.

The Terminal E Modernization project consisted of a new addition of approximately 600,000 SF, as well as 250,000 SF of existing terminal extending from the 2016-completed crescent addition, which served Gates E10, E11, and E12. This new addition extended and continued the existing Terminal E levels 1, 2, and 3, with minimal elevation changes. The addition supported seven gates, E13 through E19, respectively. Phase I of this project included the first four gates, E13 through E16, with E17 through E19 completed under Phase II.

To support these gates, the Terminal E modernization included significant open-volume departure hold room spaces, retail and food concession spaces, new TSA security screening checkpoints, and circulation access to connect to the existing Terminal E, all on Level 3. Level 2 included a secure INS arrivals corridor, which connected to the existing Terminal E Customs and Border Protection entry checkpoints. Main mechanical and electrical rooms were also on Level 2. Level 1 contained predominantly baggage handling, checked baggage inspection systems (CBIS), and aircraft support services.

Executed in several phases over more than a decade, the Massachusetts Port Authority (Massport) had the vision and determination to complete the project while remaining flexible. For example, during preliminary design, the terminal was over the established budget.



Photo courtesy of AECOM

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

**Logan International
Airport (BOS), Boston,
MA**

The design and construction team targeted the values for each program element, right sized each functional element and reduced the terminal square footage by nearly 40 percent — without sacrificing terminal operations or passenger experience. The scope of work was divided into two phases to be performed over the course of approximately two years. Arora was responsible for critical heating and cooling engineering elements for the new structure, which tied into the heating and cooling systems from the existing Central Utility Plant. Under this expansion, the Central Utility Plant needed to be upgraded to increase chilled water (CHW) and high-temperature hot water (HTHW) capacity with direct distribution to the Terminal E Modernization. The project team personnel, having extensive experience with the BOS central utilities, including extending over a mile of HTHW and CHW piping from Terminal A to and through Terminal B, proposed the use of small parallel heat exchangers and variable-speed demand-responsive pumping within the terminal, which enabled efficiency, redundancy, and reliability while accommodating seasonal load profiles.

PHASE I

Arora provided full MEP, fire/life safety, and special systems engineering as well as on-site construction management services for the addition of approximately 95,000 SF known as the Cresant to Terminal E as well as the extensive modernization of existing 900,000 SF terminal. The completed Cresant addition provided three new A380 Gates with dual passenger boarding bridges for expedited two-level boarding, automated aircraft docking guidance systems (ADGS) with an integrated ramp information display system (RIDS), full capacity 400Hz, and pre-conditioned air ground support systems, addition of departure level holding rooms and arrivals level de-boarding areas, new concession spaces, and other support spaces. The existing terminal modifications included modernization upgrades to the GSE equipment at the ten existing gates to accommodate an expanded aircraft fleet mix and optimized operations with the addition of ADGS and RIDS, a security checkpoint expansion as well as modernization of the departures and arrivals area. The project was charged with including design for technology expected to echo the spirit of innovation in the City of Boston and surrounding areas.

SCOPE OF WORK: PHASE 1

Mechanical systems included new HVAC systems and modifications to the existing HVAC systems to accommodate the new loads. To serve the cooling and heating needs of the building addition, chilled and high temperature hot water were supplied by the existing central plant. A new mechanical pump room was installed in the mechanical crawl space, and the existing 10-inch CHW and 6-inch HTHW taps provided were extended. The new pump room was equipped with HTHW to GHW heat exchangers for the pre-heat coils, and HTHW to HW heat exchangers were provided for the heating water system. The pump room was also provided with GHW and HW circulation pumps controlled by variable frequency drives (VFDs), in addition to the heating system pumps CHW supply pumps equipped with VFDs were also provided for serving the cooling loads. The pumps were provided in an N+1 arrangement for redundancy.

Plumbing systems consisted of new rain leaders, multiple new men's and women's restroom groups, and extensions of sanitary, sanitary vent, and domestic water services for future connection by Club level tenants. The project included Smart Restroom systems for six new concourse restroom groups. The restrooms were fully integrated with the existing TRAX system at BOS and included stall

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

occupancy systems, throughout counters, customer survey tablets, and BLE beacons to interact with TRAX-enabled custodial tablets that supported cleaning alerts/acknowledgements, location reporting, checklist/cleaning status reporting, dashboards for cleaning status, etc.

Electrical design consisted of a new 13.8KV 28MW Circuit from Ever Source Utilities, two new 3750KVA unit substations, revised MV automatic switching and sequence of operations for the addition and existing terminal. New Main-Tie Main SWBDS, electrical rooms, and all electrical power panels, feeders, emergency generator and complete apron and terminal lighting were provided as well. The modernization of the existing 900,000 SF terminal also included replacement of the MV Substations and Main-Tie-Main SWBD's and Distribution. This required detailed multistep phasing plans to maintain all terminal operations. Complete OCP selective coordination, short circuit and arc flash analysis was provided from the utility relays to the last OCP device in the system. These upgrades and analysis provided significant enhanced reliability and redundancy for the entire facility.

Special systems engineering services included a public address system, universal cabling distribution system, voice/data network, passenger information systems, RIDS / gate docking systems, master clock, infrastructure for boarding, and infrastructure for tenant spaces.

Fire protection/life safety systems included sprinkler systems, fire pumps, incoming fire service/available water supply, standpipes, critical asset protection, fire alarms, mass notification systems, smoke management, fire/smoke dampers, passive and active fire/smoke barriers, and egress paths, illumination, and signage.

PHASE II

Arora was selected as part of the team to provide professional engineering services for the \$800-900 million modernization of Terminal E, to efficiently accommodate current and projected international operations and passengers. The Terminal E Modernization Project extended the existing concourse, terminal core, and terminal roadway frontages.



The Terminal E Modernization project was a new addition of approximately 600,000 SF, as well as 250,000 SF of existing terminal extending from the 2016-completed crescent addition, which served Gates E10, E11, and E12. This new addition extended and continued the existing Terminal E levels 1, 2, and 3, with minimal if any elevation changes. The addition supported seven gates, E13 through E19, respectively. Phase I of this project included the first four gates, E13 through E16, with E17 through E19 completed under Phase II.

To support these gates, the Terminal E Modernization included significant open-volume departure hold room spaces, retail and food concession spaces, new TSA security screening checkpoints, and circulation access to connect to the

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

existing Terminal E, all on Level 3. Level 2 included a secure INS arrivals corridor, which connected to the existing Terminal E Customs and Border Protection entry checkpoints. Main mechanical and electrical rooms were also on Level 2. Level 1 was predominantly for baggage handling, checked baggage inspection systems (CBIS), and aircraft support services.

Electrical/Special Systems

- + Identified location of new medium voltage switching station.
- + Developed initial loading calculations for proposed equipment (HVAC, Baggage Handling, Lighting, Jet bridge loads and general power) to provide initial sizing of planned unit-substations.
- + Identified existing baggage unit substation that will be impacted by construction of new terminal.
- + Planned location of new Massport medium voltage switching station.
- + Reviewed airside civil planning with the prime to discuss underground utilities (communications) located under or near proposed Big E footprint that will require investigation and identification prior to developing design recommendations for remediation.



Mechanical

- + Estimated order of magnitude CHP thermal loads both independently and then in concert with parallel CHP project design teams.
- + Walked utility tunnels and paths for new CHW and HPS piping.
- + Performed and tested preliminary calculations based on area, population, and associated ventilation outside air loads, weight against empirical values for similar projects at Massport.
- + Weighed different HVAC applications (e.g. displacement ventilation vs. conventional VAV) for the several occupancy classes.
- + Developed initial AHU selections and configurations for the various occupancy classes.
- + Developed initial mechanical room space allocations including shaft areas with future service provisions.
- + Developed initial electrical loads to support power distribution development.
- + Evaluated system scope iterations with proposed phasing alternatives.
- + Initial LEED® checklist analysis. Coordination with sustainability efforts.

Plumbing

- + Initial order of magnitude preliminary calculations for water distribution, sanitary and grease waste for the following areas:
 - + General toilet room facilities

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

For the main substation space, a load calculation was performed converting the transformer rated kVA capacity into anticipated heat gain to the spaces due to transformer inefficiency. This was converted to a heat gain in BTU/hr and based upon assumed supply air and space temperatures, a required cooling airflow requirement was determined for each of the spaces within the overall substation area. See attached "Boston Terminal E Transformer Room Heat Gain Calculation".



To serve this need, two 20,000 CFM hydronic cooling only air handling units with full economizer operation were provided. Refer to schedule on attached drawing M8.101 with units in question highlighted. Two units were provide with one normally operating and the other standby in case of primary unit failure, as loss of cooling in this vital space would have rendered the terminal non-operable. The units were provided with both chilled water from the CUP for summer operation as well as economizer capability to use cold outdoor air during the winter when the CUP chillers are not in service. Refer to drawings M1.204 & M1.210 for the annotated drawings indicating the location of these units and associated ductwork, illustrating how these spaces were served.

With chilled water only seasonally available, its sole use for the scattered electrical rooms was not possible. Also, with these small spaces scattered about the terminal, use of local air handling units with economizer capability would not have been practical. So, for the scattered electrical rooms the design solution included a variable refrigerant flow (VRF) system, which would be capable of cooling these spaces year round (as well as heating them, if needed). The VRF systems were arranged to serve the electrical rooms, as well as the adjacent IDF and MDF spaces, in their part of the terminal. Note that due to the sheer size of the terminal, multiple VRF systems were required. This was because as the internal volume of the VRF system refrigerant piping became too large (due to the scattered spaces served), the system refrigerant charge increased to where there should have been a leak the refrigerant concentration in the spaces would have exceeded the maximum allowed under ASHRAE 15, the refrigeration code which governed maximum refrigerant concentration resulting from piping leaks. The equipment schedules for the exterior VRF Condensing Units and associated indoor Wall Mounted Variable Refrigerant Units are shown on attached drawing M8.104. In addition, also attached are two dozen floor plans numbered between MR1.102 and MR1.202 that show

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

- + Developed initial mechanical room space allocations, including shaft areas with future service provisions
- + Developed initial electrical loads to support power distribution development
- + Evaluated system scope iterations with proposed phasing alternatives
- + Initial LEED® checklist analysis. Coordination with sustainability efforts
- + Initial order of magnitude preliminary calculations for water distribution, sanitary and grease waste for the following areas: general toilet room facilities, domestic water for potable water cabinets, concession space, club space
- + Performed design and calculations for water distribution, sanitary and, grease waste
- + Performed design and calculation for redundant domestic water feed for terminal
- + Performed design and calculation for hot water supply to fixtures
- + Performed LEED® checklist analysis. Coordination with sustainability efforts
- + Review of roof area and roof levels for drainage
- + Redundant domestic water feed for terminal

Plumbing

Initial order of magnitude preliminary calculations for water distribution, sanitary, and grease waste for the following areas:

- + General toilet room facilities
- + Domestic water for potable water cabinets
- + Concession space
- + Club space
- + Performed design and calculations for water distribution, sanitary, and grease waste
- + Performed design and calculation for redundant domestic water feed for terminal
- + Performed design and calculation for hot water supply to fixtures
- + Performed LEED® checklist analysis. Coordination with sustainability efforts
- + Review of roof area and roof levels for drainage
- + Redundant domestic water feed for terminal

Fire Alarm / Fire Protection

Fire Alarm - The BOS Terminal E program modified and expanded the existing Johnson Controls (Simplex) fire alarm network that served Terminal E and were designed in accordance with NFPA-72 and all local codes, standards, and client guidelines. The project required the addition of 15 fire alarm nodes to accommodate the expanded building footprint, more than doubling the existing 14-node system. The new nodes included all signaling line circuit (SLC) cards, notification appliance circuit (NAC) cards, power supplies, amplifiers, and networking hardware

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

In addition to the fire alarm nodes a second Fire Operations Center (FOC) was added to Terminal E to provide a redundant location for emergency management within the Terminal. The new FOC included a fire alarm workstation that indicated the status of the Terminal E fire alarm system, as well as the entire airport network, and a paging microphone to transmit live voice messages directing occupants in the event of an emergency. In addition to the FOC remote annunciator panels with microphones were provided approximately every 200 ft within the public spaces to allow for additional locations for emergency managers to transmit live voice messages to the occupants.

The fire alarm design for the terminal expansion included approximately 600 new initiation and interface devices to detect a fire and integrate with fire/life safety building systems. These devices included manual pull stations, area smoke detectors, heat detectors, duct detectors, duct detector remote test stations and input/output modules for the supervision and control of the building's life/safety systems. In addition, the design included over 400 notification appliances, including speakers, strobes, and combination speaker/strobes, to provide audio and visual notification of fire and emergency events.

The Terminal E program also included modifications to existing building areas required to facilitate the interface with the terminal expansion as well as improvements to existing customer experience areas. To accommodate this work the fire alarm design included the demolition, relocation of existing and addition of new fire alarm field devices including initiation and interface devices and notification appliances. The terminal was required to remain fully occupied and operational throughout construction which required the fire alarm design to address phased construction with temporary means and methods to ensure all existing fire alarm devices and functionality remained fully operational.

Fire Protection- The fire protection systems for the Terminal E program were designed in accordance with NFPA-13, NFPA-14 and all local codes, standards, and client guidelines. The building expansion included both sprinkler and standpipe that were supplied by two 10-inch underground fire water service mains and double check backflow preventers. The water services were remotely located and interconnected with each other the existing terminal via sectionalizing valves to provide redundant water service to the new fire protection systems. In addition, five fire department connections for use by the responding fire department were located on the exterior of the terminal expansion.

The building was classified as fully sprinklered and provided with both wet and dry sprinkler systems throughout. The expansion included 22 new wet sprinkler systems to protect interior, conditioned spaces of the terminal and included all fire alarm supervision including water flow and tamper switches to monitor system status. For exterior and non-conditioned areas, such as baggage handling tug drives and exterior soffits, the building was provided with 12 dry sprinkler systems and a centralized nitrogen generator system which were supervised via waterflow pressure, low air pressure and tamper switches to monitor system status.

The new terminal was provided with a new interconnected standpipe system located within all egress stairs and at horizontal exits to meet a code required maximum travel distance of 200 ft. The new system was interconnected with the existing terminal standpipe system and included 39 new fire hose valves for use by the responding fire department. The site water supply was adequate to meet the hydraulic demand of the new sprinkler systems without a fire pump. However, it

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

not sufficient to meet the code required 100 psi standpipe demand. To provide a code compliant standpipe system, the design team reviewed the applicable codes and determined that, with the approval of the local authority having jurisdiction, the standpipe system could be classified as a Manual Wet Class I system. The issue was thoroughly reviewed with the client and the local fire chief, and all parties agreed that this approach was code compliant and aligned with the facility's current standards.

In addition to the terminal expansion the fire protection systems in the existing Terminal E were modified to maintain code compliant sprinkler and standpipes system of the renovated areas. To ensure the existing building could remain occupied during construction, careful design and planning was required to maintain sprinkler and standpipe service. The fire protection design included careful review of existing conditions as well as temporary piping to and sprinklers to maintain service outside the areas of work.

Fire Alarm / Fire Protection

- + Compared different fire alarm system applications/approaches (e.g. area detection, aspiration detection, linear detection, beam smoke detection and smoke imaging detection vs. typical conventional and addressable fire alarm system methods).
- + Evaluated system scope iterations with proposed phasing alternatives.
- + Performed initial code analysis review for fire protection design.
- + Developed initial fire zone plans.
- + Coordinated with the civil team to determine locations for the primary and redundant fire service main into the new building.
- + Established zone control assemblies for wet systems will be located in staircases.
- + Developed initial fire pump room space allocation if required.
- + Fueling points were coordinated to be at least 100 feet away from the building to avoid requirements for Deluge Sprinkler Systems.

Sustainability

Massport's mission was to create a sustainable, highly-efficient, resilient building that prioritizes the healthy and safety of its occupants. Terminal E was designed to serve as a noise barrier to the nearby East Boston neighborhoods and will achieve energy efficiencies at least 20% better than MA Energy Code dictates. Improvements include dynamic glass to provide shade, lower energy and greenhouse gas emissions, water conservation, air quality improvements, reduced energy consumption, improved water and storm water quality, and additional waste management and recycling.

- + To meet the sustainability goals of LEED Gold certification, the HVAC, plumbing and electrical systems were designed with high efficiency equipment. The HVAC system was modeled to use district heating and cooling system that served high efficiency air handling equipment. The plumbing systems for the new building addition was designed to minimize the use of domestic water and reduce the energy used for generating domestic hot water.
- + Low flow plumbing fixtures were used in restrooms to reduce the domestic water usage. Electrical systems employed lighting fixtures such as light emitting diode (LED) and lighting control systems to reduce the energy usage. The lighting control system used day lighting strategies that reduce the output of lighting fixtures if the outdoor lighting was sufficient to maintain the desired lighting levels inside the building.

MASSACHUSETTS PORT AUTHORITY

TERMINAL E MODERNIZATION

Logan International
Airport (BOS), Boston,
MA

BIM

Arora provided LOD 350 models of the above noted systems, providing Massport with a fully functional model that included construction documents with load calculations, lighting, and other critical system details. To simplify the construction process, the team provided extensive clash coordination and model QA/QC services to ensure that system designs did not interfere with the other architectural, structural, or system models and that the BIM model recorded exact conditions with no interferences. With a project of this magnitude, clashes were one of the most common challenges the design and construction teams faced, so the team made sure to work closely with the other design team members to try to limit interference while untying clashes.

Work Order #7- Add Fee 97117.002

- + Arora provided mechanical, electrical, plumbing, special systems, and fire/ life safety engineering services to identify Terminal E base building elements that needed to be modified to accommodate a future air cargo facility under and in front of the terminal footprint. This also included modifications that were necessary on the site, outboard of the terminal footprint, to be modified and/or relocated to accommodate the program. Arora also helped establish the “working” area of a future through cargo facility under the terminal and will be a coordinated effort to re-route the MEPs to avoid these areas.
- + The overall goal was to provide unimpeded tenant space for a fully operational and flexible cargo operation in the future. The as-designed systems were be evaluated, and the team identified those elements that should not be built until a fully coordinated set of design documents can be prepared.

Work Order #1F CA Services- Add Fee 97117.003

- + Arora provided mechanical, electrical, plumbing, and fire/ life safety engineering services for the construction administration services for BOS Terminal E Enhancements.

Work Order #8- Ticket Counter & Hall Extension: Add Fee - 97117.004

- + Arora provided mechanical, electrical, plumbing, special systems, and fire/ life safety engineering services for the expansion of the ticketing to the west of the current ticket counter lobby. It replaced the already designed and bid retail shell that was deferred at the east end of the new checkpoint.
- + The re-design of the retail shell area included the addition of 16 ticket counters, scales, and other devices, backdrop, floor, ceiling, and wall finishes, lighting suitable for a checkpoint operation and queue along with take away belts, structural modifications, and tie ins to the existing BHS system. In addition, the scope of work included modifications to the paging system, IT, and security/CCTV systems as well as MEP and fire protection systems.

IN THE MEDIA:

<https://aecom.com/blog/airport-terminal-designs-for-the-future-build-in-design-flexibility-and-be-prepared-to-pivot/>

PROJECT DETAILS

Client

Nashville International Airport
Traci Holton, PE, CM
Assistant Vice President
Development & Engineering
One Terminal Drive, Ste. 501
Nashville, TN 37214
Traci.Holton@flynashville.com
615-275-4139

Construction

\$327,000,000

Project Start

2018

Project Completion

2023

Highlights

- + Providing special systems engineering and design services for BNA's Terminal Lobby and International Arrivals Facility (IAF).
- + Special systems included public address, Electronic Video Information Display Systems (EVIDS), and the integration of those systems.
- + The project spanned 210,000 square feet of new space and 350,000 square feet of renovated space.

METROPOLITAN NASHVILLE AIRPORT AUTHORITY BNA TERMINAL LOBBY AND INTERNATIONAL ARRIVALS FACILITY (IAF)

Nashville International Airport, Nashville, TN

As part of BNA Vision, an expansion plan at Nashville International Airport (BNA), the Metropolitan Nashville Airport Authority (MNA) renovated the Terminal Lobby and designed a new International Arrivals Facility (IAF).

This design-build project included a new high roof canopy extending from Parking Garage B/C to the new International Arrivals Facility. The canopy provided coverage over the roadways and curbside access to the terminal as well as a new pedestrian walkway connecting the parking garage to the terminal. The pedestrian bridge connected the central core with the Garage B/C plaza, the administration building, the hotel, and the future train station to improve accessibility to and from the airport terminal. The terminal also included a new consolidated Security Screening Checkpoint (SSCP). The SSCP was located central to the terminal, providing easy access to departing passengers. The SSCP included biophilia opportunities through low-maintenance vertical garden walls. The terminal renovation also included new concessions, airline club space, and gates serving international flights.

The project also included a new International Arrivals Facility (IAF), which provided a new Customs and Border Protection (CBP) Area with primary and secondary processing, complete with a pedestrian tunnel moving the passengers from the CBP to the Terminal and Ground Transportation areas

Scope of work included:

Arora Engineers (Arora), as part of the Hensel Phelps and Fentress Architects led Design/Build team, was selected to provide special systems engineering and design services for this project, including public address and Electronic Video Information Display Systems (EVIDS), as well as the integration of those systems into common-use terminal equipment. Passengers will be greeted by two monumental displays playing gorgeous video capsules that pay homage to Music City's legacy. Each large-scale screen stands at 70 x 10 feet. This project incorporated 210,000 square feet of new space and 350,000 square feet of renovated space.



Metropolitan Nashville Airport Authority

PROJECT DETAILS

Client

AIR Alliance Joint-Venture
Robert J. Kleinman
Vice President – Aviation
3101 Wilson Boulevard, Suite
700
Arlington, VA 22201
robert.kleinman@aecom.com
703-399-3914

Construction

\$269.8 Million

Project Start

2017

Project Completion

2021

Highlights

- + New Secure National Hall
- + Sufficient room for TSA equipment
- + Heightened security at airport
- + Improved the screening experience
- + Arora provided plumbing, fire alarm, and fire protection engineering services

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

SECURE NATIONAL HALL

Ronald Reagan National Airport, Washington, DC

Arora Engineers (Arora) was part of the joint venture team identified as AIR Alliance, comprised of AECOM and PGAL for the new Secure National Hall project at Ronald Reagan Washington National Airport (DCA). The Metropolitan Washington Airports Authority (MWAA) procured professional engineering services for on-call planning, design, and construction projects at DCA as part of Project Journey, a billion-dollar, multi-year capital improvement program designed to transform the passenger experience at DCA. The new Secure National Hall was designed to heighten security at the airport and improve the screening experience for passengers and TSA officers.

The new 100,000 square foot checkpoints, located in the airport's iconic Secure National Hall, expand TSA's screening operation from 20 to 23 total lanes, with the ability to expand to a total of 28 lanes. Screening operations were relocated, and the new facilities engineered to create a seamless, free-flowing environment between Terminal B/C and the new 14-gate concourse. The checkpoints offered sufficient room for TSA equipment and included an area for passengers to recompose themselves after screening. This process not only increased capacity but ensured a comfortable space and experience for travelers.

The checkpoint improvements were a key part of Project Journey, which included the construction of an enclosed \$391.5 million regional aircraft concourse to offer passengers greater connectivity, more shopping and dining options, and a more gratifying post-security space.

Scope of work:

Arora's overall scope of services for AIR Alliance included plumbing, fire alarm, and fire protection engineering services for the Secure National Hall Project. Arora was



**METROPOLITAN
WASHINGTON
AIRPORTS
AUTHORITY**

**SECURE NATIONAL
HALL**

**Ronald Reagan
National Airport,
Washington, DC**

also responsible for conceptual design services integrating renovated space in the National Hall and the New North Concourse connector with the existing systems and technology at DCA. Additionally, Arora provided construction administration services for the Secure National Hall.

In providing plumbing and fire protection design services, the team produced creative solutions to accommodate the complex roof forms of the new security checkpoint buildings. Several coordination efforts took place with other disciplines for routing of the storm water piping from the new roof to the existing leaders to a below ground main. This approach yielded a very clean design of an exposed roof structure and maintaining of the aesthetic qualities of the building.

Typical fire protection systems are designed for a flat or sloped roof, so it will usually only vary in two directions. However, the roof of DCA's new security checkpoint buildings had a tilted, wave-like design, meaning the roof varied in three different directions (an XYZ system).

In the design approach, Arora was tasked with getting the sprinklers placed up high while still being able to merge with the existing wet system. Therefore, they had to consider regulating pressure losses and not exceeding the current pressure system supply. Maintaining cost and adequate safety measures were also critical to the design.

In a sprinkler system, water is always draining back to a common source for testing purposes so that the system can be inspected. In this space, the team had to look closely at the elevation in the design (foot-by-foot increments along a 400-foot span, per building), be mindful of the routing, and avoid pitfalls of low points and artificial high points. Through their creative efforts, the team matched the profile of the roof while maintaining a positive slope back to a common drain.

The team also focused on the routing below the structure, again considering the dry system they were working with. A key concern with these types of systems is protecting them from freezing while crossing through an unconditioned space. In this design, the source water was on the opposite end of the building from the point of use, so the piping had to loop back around to the ceiling. There was no right-of-way of direct piping in this design. Keeping pressure loss in mind, as well as water demand, the team had to decrease the size of each individual system while increasing the number of zones.

These constraints generated multiple iterations of the fire protection design. The system was routed half a dozen times, and the team had to collaborate with other disciplines in organizing the building systems (e.g. lighting, electrical, public address, etc.) in limited ceiling plenum. There was also an aesthetic quality to consider by maintaining the spacing from sprinkler to sprinkler.

PROJECT DETAILS

Client

PGAL
Rich Layman, AIA LEED AP
BD+C,
Associate Principal
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rlayman@pgal.com
703-836-0588

Construction

Approx. \$16,000,000

Project Start

2022

Project Completion

Est. 2023

Highlights

- + Arora provided Mechanical, Electrical, Plumbing and Fire/Life Safety and Special Systems engineering for restroom expansion and creation
- + Smart Restroom technologies utilized

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

DCA TERMINAL B/C CONCOURSE LEVEL RESTROOMS ADDITION & EXPANSION

Ronald Reagan Washington National Airport , Arlington, VA

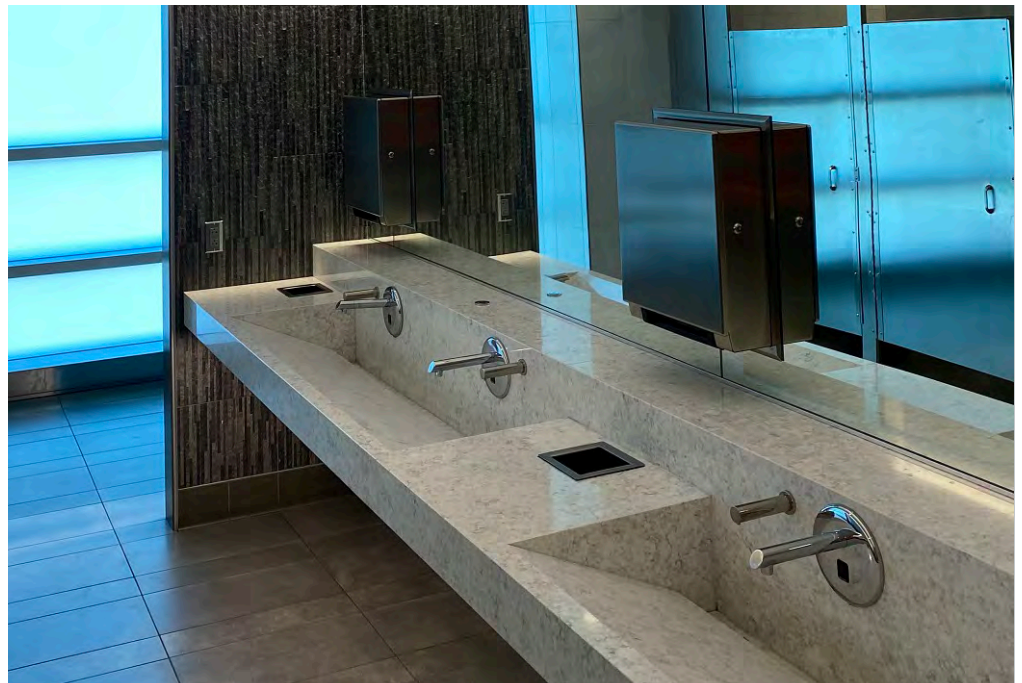
Arora Engineers (Arora) provided engineering and design services as a subconsultant to PGAL under their an on-call Architectural Engineering Design Services contract for Metropolitan Washington Airports Authority (MWAA) Facilities at Ronald Reagan Washington National Airport (DCA) and Washington Dulles International Airport (IAD),

Under this task order, the team provided multidisciplinary engineering services for the addition and expansion of restroom facilities in Terminal B/C at DCA to help meet the airport's growing passenger demand.

Scope of work included:

Arora provided mechanical, electrical, plumbing, fire alarm, fire protection, and special systems (communications/security) engineering services for the addition and expansion of restrooms at DCA.

The scope of work included design services for three new and nine expanded restroom groups. The project included other related amenities such as two Pet Relief Areas in the national hall, three Nursing Rooms in the national hall, and Family Restrooms and Universal/Baby Changing Tables in some restrooms to accommodate differently abled users. Each group of restrooms included separate restrooms for both gender's and janitorial closets.



DCA Existing Restroom Facility

**METROPOLITAN
WASHINGTON
AIRPORTS
AUTHORITY**

**DCA TERMINAL
B/C CONCOURSE
LEVEL RESTROOMS
ADDITION &
EXPANSION**

**Ronald Reagan
Washington National
Airport , Arlington, VA**

The Arora team began by conducting site visits and surveys to document existing conditions thoroughly, including:

- + Existing plumbing chases
- + Accessible above ceiling conditions
- + Existing pipe sizes (for Tie-in)
- + Spaces below and adjacent to restrooms

The the team evaluated the following:

- + New mechanical exhaust system and its impacts on make-up air requirements on existing HVAC system, and provided design to ensure positive pressure was maintained.
- + Electrical distribution system and spare capacities
- + Suitable Smart Restroom Technology to enhance utilization rate and to reduce maintenance burden.

Arora coordinated their designs with other concurrent design packages, such as the Concessions Infrastructure package, to maintain positive air pressure. The team also coordinated with the Commissioning Agent provided by MWAA on specifications requirements.

The Arora team provided complete demolition plans, new work drawings, and specifications in accordance with VUSBC 2018 and the Authority's 2020 Design Manual.

**METROPOLITAN
WASHINGTON
AIRPORTS
AUTHORITY**

**CONCOURSE
C/D SKYLIGHTS,
ROOF TOP UNITS,
AND BOILERS
REPLACEMENT**

Washington Dulles
International Airport
(IAD), Dulles, VA

PROJECT DETAILS

Client

AIR Alliance Joint-Venture
Robert J. Kleinman
Vice President – Aviation
3101 Wilson Boulevard, Suite
700
Arlington, VA 22201
robert.kleinman@aecom.com
703-399-3914

Construction

\$391,500,000

Project Start

2016

Project Completion

2021

Highlights

- + New North Concourse
- + Arora provided electrical, plumbing, and fire/life safety engineering services.
- + Added 200,000 SF to DCA

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

NEW NORTH CONCOURSE

Ronald Reagan National Airport, Washington, DC

Arora Engineers (Arora) was part of the joint venture team identified as AIR Alliance, comprised of AECOM and PGAL for the New North Concourse at Ronald Reagan Washington National Airport (DCA). This project was funded by the Metropolitan Washington Airports Authority (MWAA), who procured professional engineering services for on-call planning, design, and construction projects at DCA.

The New North Concourse project consisted of an addition to Terminal B/C to facilitate expanded airline operations with 14 new gates, several concessions spaces, and airport operations. The project added approximately 200,000 SF to DCA.

This was a multi-year, multi-task A/E task order program for Terminal B/C at DCA. The program objective was to centralize TSA operations for passengers and secure and expand the existing Terminal B/C to ensure equitable and efficient passenger level of service. The long-term redevelopment complemented the on-going near-term rehabilitation efforts and led to a full facility program.

Scope of work included:

Arora provided full electrical, plumbing and fire/life safety engineering services for the New North Concourse project. Arora was also responsible for conceptual design services integrating renovated space in the National Hall and the New North Concourse connector with the existing systems and technology at DCA. Additionally, Arora provided Construction Administration services for the New North Concourse



Photo courtesy of MWAA

In the News:

"All in Due Concourse" article featured in the Winter 2022 issue of ArchitectureDC,
<https://flipbook.hbp.com/Winter2022/>

PROJECT DETAILS

Client

AIR Alliance Joint-Venture
Robert J. Kleinman
Vice President – Aviation
3101 Wilson Boulevard, Suite
700
Arlington, VA 22201
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703-399-3914

Construction

\$390 Million

Project Start

2015

Project Completion

2022

Highlights

- + Multi-year, multi-task program for upgrades at DCA
- + Relocation of corporate offices
- + New North Concourse
- + New Secure National Hall

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

TERMINAL B/C LONG-TERM REDEVELOPMENT PLAN

Ronald Reagan National Airport, Washington, DC

The Metropolitan Washington Airports Authority (MWAA) procured professional engineering services for on-call planning, design and construction projects at Ronald Reagan Washington National Airport (DCA). This was a multi-year, multi-task A/E task order program for Terminal B/C at DCA. The program objective was to centralize TSA operations for passengers and secure and expand the existing Terminal B/C to ensure equitable and efficient passenger level of service. The long-term redevelopment complemented the on-going, near-term rehabilitation efforts and led to a full facility program.

Arora Engineers (Arora) was part of the joint venture team identified as AIR Alliance, comprised of AECOM and PGAL. The overall scope of services for AIR Alliance included plumbing, electrical, fire alarm, and fire protection engineering services.

Scope of work included:

- + Relocation of the Airport Corporate Offices to Historic Terminal A: Consisted of the assessment, preliminary design, report, and cost estimate for the Terminal A alterations and fit-out for authority corporate offices. Provided full MEP services.
- + A New North Concourse (NNC): Project consisted of an addition to Terminal B/C to facilitate expanded airline operations with 14 new gates, several concessions spaces, and airport operations. The project added approximately 200,000 SF to DCA. Provided full electrical, plumbing, and fire life safety.
- + A new Secure National Hall (SNH): Project aimed to relocate three individual TSA screening operations into a centrally located space while securing the existing concourse, approximately 110,000 SF of new structures added to DCA. Provided



Rendering courtesy of MWAA

**METROPOLITAN
WASHINGTON
AIRPORTS
AUTHORITY**

**TERMINAL B/C
LONG-TERM
REDEVELOPMENT
PLAN**

Ronald Reagan
National Airport,
Washington, DC

plumbing and fire life safety services.

- + Arora was responsible for conceptual design services and integrating renovated space in the National Hall and the New North Concourse connector with the existing systems and technology at DCA.
- + Construction administration services for the NNC and SNH.

PROJECT DETAILS

Client

Gresham Smith
Kristy Cameron
Associate, Ops.Coordinator
DAL+ RIC Division
919 East Main Street, Suite
1200 Richmond, VA 23219
804-344-2455
Kristina.Cameron@
greshamsmith.com

Project Start

2017

Project Completion

2020

Highlights

- + AFM Risk Analysis
- + EVID Signage
- + FIDS Display Systems
- + Energy Saving Plan

NORFOLK AIRPORT AUTHORITY (NAA)

NORFOLK INTERNATIONAL AIRPORT (ORF) ARCHITECTURAL SERVICES ON-CALL

Norfolk, VA

Arora Engineers (Arora) was selected as an on-call subconsultant at Norfolk International Airport (ORF) to provide on-going engineering services. Arora's scope of work included Fire Life Safety review and Special Systems scope that was completed over a consecutive four-year term.

Scope of work included:

TASK 1 - Fire/Life Safety (FLS) Engineering

Arora was tasked with providing a review of the AFM Risk Reports. The report addressed each AFM recommendation and provided a description of the associated existing conditions noted during the site survey, a description of existing procedures per discussions with facility stakeholders, recommended actions, scheduling and "grouping" of the recommendations and rough order of magnitude (ROM) cost estimates. The report outlined regular fire pump testing, sprinkler valves inspections and reinforcement, increased protection for transformers, and protection against fuel spills and fire.



TASK 2 & 3 - FIDS Display Systems Upgrade & Replacement

Arora updated the technical specifications for the ITS Flight Information Display Systems and display controllers. controllers. Arora included such FIDS features as:

- + Cloud hosted option
- + Flight Data
- + Weather
- + Visual Paging
- + Marketing
- + Static digital directories
- + Manual inputs for messaging



TASK 4 - Curbside EVIDS Replacement

Arora provided the removal of the existing curbside EVIDS which were individual single line multicolor LED's enclosed in a signage cabinet. Arora specified new EVIDS as well as mounting elements, power, data and programming requirements.

**NORFOLK AIRPORT
AUTHORITY (NAA)**

**NORFOLK
INTERNATIONAL
AIRPORT (ORF)
ARCHITECTURAL
SERVICES ON-CALL**

Norfolk, VA

TASK 5 - Interior Signage EVIDS

Arora provided two new large digital display boards integrated with static signage within the departure's atrium. Arora determined the appropriate technology and display sizes.

TASK 6 - Lighting Study for Energy Conservation

Arora evaluated the existing interior and exterior lighting and provided recommendations to save energy and reduce operating costs. The areas at ORF that were evaluated included the entire main terminal (including both concourses), apron lighting attached to concourses, Departures Building (all levels), pedestrian bridges and tunnel, Arrivals Building (all levels), and Garages A, B, and C. Building (all levels), and Garages A, B, and C.

PROJECT DETAILS

Client

Five Star Electric Corp.
Allen Hirsch
350 West 31st St., 6th Floor
New York, NY, 10001
AHirsch@fivestartelectric.net
718-641-5000 ext. 48003

Construction

\$1,200,000,000

Project Start

2018

Project Completion

2022

Highlights

- + Providing TSE expert construction phase services
- + Verifying all airport systems and integrations are tested and function in accordance with design phase documentation
- + Assisting in all testing, commissioning and operationalization of airport systems

PORT AUTHORITY OF NEW YORK AND NEW JERSEY EWR TERMINAL A REDEVELOPMENT PROGRAM – TECHNICAL SUPPORT EXPERT SERVICES

Newark International Airport, Newark, NJ

The Port Authority of New York and New Jersey (PANYNJ) undertook the Newark Liberty International Airport (EWR) Terminal A Redevelopment Program. The new Terminal One replaced Terminal A and was estimated to be three stories high and approximately 1.2 million square feet (SF) in area. Terminal One included a centralized arrivals/departures hub, passenger and baggage processing systems, and three radiating concourses to service 33 aircraft gates. Arora Engineers (Arora) provided Master Systems Integrator (MSI) and Technical Systems Expert (TSE) services under the electrical contractor Five Star Electric.

Scope of work included:

Arora provided Technical Systems Expert Services (TSE) to the Functional Systems Expert (FSE) to guide the FSE through construction phase services for the successful integration of airport systems. Key activities included

- + Reviewing RFC drawings and identifying performance criteria vs. out of scope items (assessment)
- + Reviewing vendor shop drawings, and coordinating vendor interfaces and shop drawings with one another
- + Coordinating and scheduling third-party testing agencies
- + Developing special systems delivery and construction schedule
- + Developing testing and commissioning plan(s)
- + Developing tracking mechanisms for systems tests and requests
- + Reviewing disparate systems product data and shop drawing submittals, reviewing



Photo Credit: Grimshaw Architects

**PORT AUTHORITY OF
NEW YORK AND NEW
JERSEY**

**EWR TERMINAL A
REDEVELOPMENT
PROGRAM –
TECHNICAL
SUPPORT EXPERT
SERVICES**

**Newark International
Airport, Newark, NJ**

and consolidating shop drawings

- + Generating integration shop drawings containing detailed schematics, data, programming and software, and process information for the integrations between access control, CCTV and fire alarm systems

Together with FSE, Arora verified that all airport systems and integrations were tested and functioned in accordance with the design phase documentation and assisted in all testing, commissioning, and operationalizing of airport systems.

PROJECT DETAILS

Client

STV – Buildings & Facilities
Division
Anton Nelson, PE
225 Park Avenue South
New York, NY 10003
Anton.Nelson@stvinc.com
646-388-5104

Construction

\$2,700,000,000

Project Start

2018

Project Completion

2023

Highlights

- + Providing special systems, fire/life safety, technical systems, and airside design engineering and CA services for the EWR Terminal A Redevelopment Program
- + Fire/life safety design includes the Pedestrian Bridge and Generator Building
- + Special systems design included MUFIDS/EVIDS, common use systems, public address/audio paging systems, etc.
- + Airside design included new 33-gate terminal building and ramp

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

EWR TERMINAL A REDEVELOPMENT PROGRAM

Newark International Airport, Newark, NJ

The Port Authority of New York and New Jersey (PANYNJ) embarked on the largest Design/Build project in New Jersey history with the Redevelopment of Terminal A at Newark Liberty International Airport (EWR). The new Terminal A is three stories high and 1 million SF in area. Terminal A includes a centralized arrivals/departures hub with world-class dual-sided roadways and over 1,000ft of upgraded curb frontage to ease passenger movement and improve passenger and baggage processing systems and three radiating concourses to service 33 aircraft gates. The facility also houses a hospital-grade air filtration system and other amenities like self-check in, self-serve bag drop stations, and biometric upgrades to expedite security screening and offer touchless payment options for concessions.

Arora Engineers (Arora) provided fire/life safety and special systems engineering and construction administration services for this program under the Tutor Perini Design Build Team as a sub-consultant to STV. In addition, Arora served as Master Systems Integrator (MSI) and Technical Systems Expert (TSE) under the electrical contractor Five Star Electric, as well as provided electrical, plumbing and special systems engineering services as a subconsultant to AERO Systems Engineering, Inc. (Aero) for the Airside Gates during design development, construction documents, and construction administration phases of work.

Scope of work included:

Special Systems – Special systems engineering design services provided for the new Terminal A included:

- + Low voltage design and engineering



Image courtesy of PANYNJ

**THE PORT
AUTHORITY OF NEW
YORK AND NEW
JERSEY**

**EWR TERMINAL A
REDEVELOPMENT
PROGRAM**

**Newark International
Airport, Newark, NJ**

- + Electronic Video Information Displays (EVIDS)
- + Airline operations and support
- + Common use systems
- + Emergency mass notification
- + Public address/audio paging system
- + Taxi dispatch systems
- + Visual messaging systems
- + Visual docking guidance system
- + Visual paging
- + Virtual apron, control room, terminal operations center, and emergency operation control center, which comprise the Integrated Terminal Operations Control Center (ITOCC) – Services included:
 - + Identifying structured cabling for necessary equipment, including audio, visual systems and IT systems for workstations
 - + Delivering the complete ITOCC system design
- + Structured Cabling System and horizontal backbA (SCS)
- + Telecommunications spaces (MDF, IDF, radio rooms)
- + Telephone (VoIP and traditional)

Fire/Life Safety – As the lead engineer for fire alarm and fire protection, Arora performed engineering services for the new vertical structures of the new Terminal A, as well as the Pedestrian Bridge and Generator Building. The Pedestrian Bridge connected Terminal A to the new parking garage, designed and constructed separately, adjacent to the P1 Airtrain Station. The standby Generator Building, located south of Terminal A, supported the new facility. The design included standard wet and dry water-based sprinkler and standpipe systems as well as deluge sprinkler, pre-action sprinkler, and gaseous suppression systems for high-value or high-challenge assets.

Construction Administration – Arora provided construction administration for special systems and fire protection engineering services to the design team, which included reviewing submittals, reviewing RFIs, attending meetings, and performing inspection.

Technical Systems – Arora provided Technical Systems Expert Services (TSE) to the Functional Systems Expert (FSE) to guide the FSE through construction phase services for the successful integration of airport systems. TSE services included but were not limited to the following:

- + Reviewing RFC drawings and identifying performance criteria vs. out of scope items (assessment)
- + Reviewing vendor shop drawings and coordinating vendor interfaces and shop drawings with A another
- + Coordinating and scheduling third-party testing agencies
- + Developing special systems delivery and construction schedule

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

EWR TERMINAL A REDEVELOPMENT PROGRAM

Newark International
Airport, Newark, NJ



Image courtesy of PANYNJ

- + Developing testing and commissioning plan(s)
- + Developing tracking mechanisms for systems tests and requests
- + Reviewing disparate systems product data and shop drawing submittals, reviewing and consolidating shop drawings
- + Generating integration shop drawings containing detailed schematics, data, programming and software, and process information for the integrations between access control, CCTV and fire alarm systems

Together with FSE, Arora verified that all airport systems and integrations were tested and functioned in accordance with the design phase documentation, assisted in all testing, commissioning and operationalizing of airport systems.

Airside Design – Arora provided electrical, plumbing and special systems engineering services for the Airside Gates as part of this redevelopment program, which included a new 33-gate terminal building and ramp. Services for the Airside Gates are defined as follows:

- + Communications, data, CCTV, security supporting:
 - + PBB's, PCA, 400Hz, potable water, bag valet, ADGU, RIDS, eGSE battery charging, EFSO and hydrant fueling system and fiber loop
- + Power supporting:
 - + Potable water, bag valet, ADGU, RIDS, eGSE battery charging, EFSO and hydrant fueling system
- + Potable water system and plumbing
- + EFSO system controls

PACC 66 Self-Bag Drop – Arora provided special systems engineering services for a low voltage design related to the check-in hall modifications to support self-bag drop, identified as PACC 66. The design and engineering scope of work included the following:

- + Revised structured cabling drawings to accommodate equipment changes including:

THE PORT
AUTHORITY OF NEW
YORK AND NEW
JERSEY

EWR TERMINAL A
REDEVELOPMENT
PROGRAM

Newark International
Airport, Newark, NJ

- + IDF room details
- + Cable schedules
- + Sleeve locations
- + Details as required
- + Specifications as required

Arora was responsible for plans, specifications, and services related to the design development, construction documents, and construction administration.

Sustainability - To meet the PANYNJ's goal of reducing greenhouse gas emissions, the new terminal features several sustainable design solutions including solar panels on the curbside glass canopy and roof of the integrated parking structure, water-efficient plumbing fixtures, electrical buses, and energy-efficient indoor lighting and controls.

In the News:

"Terminal A is expected to generate more than \$4.6 billion in regional economic activity, create more than 2,500 jobs and provide more than \$1.9 billion in wages. As of June 2022, the Terminal A program had awarded 94 sub-contracts to minority and women-owned business enterprises (MWBE) totaling more than \$686 million and \$213 million for 92 sub-contracts to New Jersey firms."

Learn more here: <https://www.panynj.gov/port-authority/en/press-room/press-release-archives/2022-press-releases/governor-phil-murphy--port-authority-leaders--state-and-local-of.html>

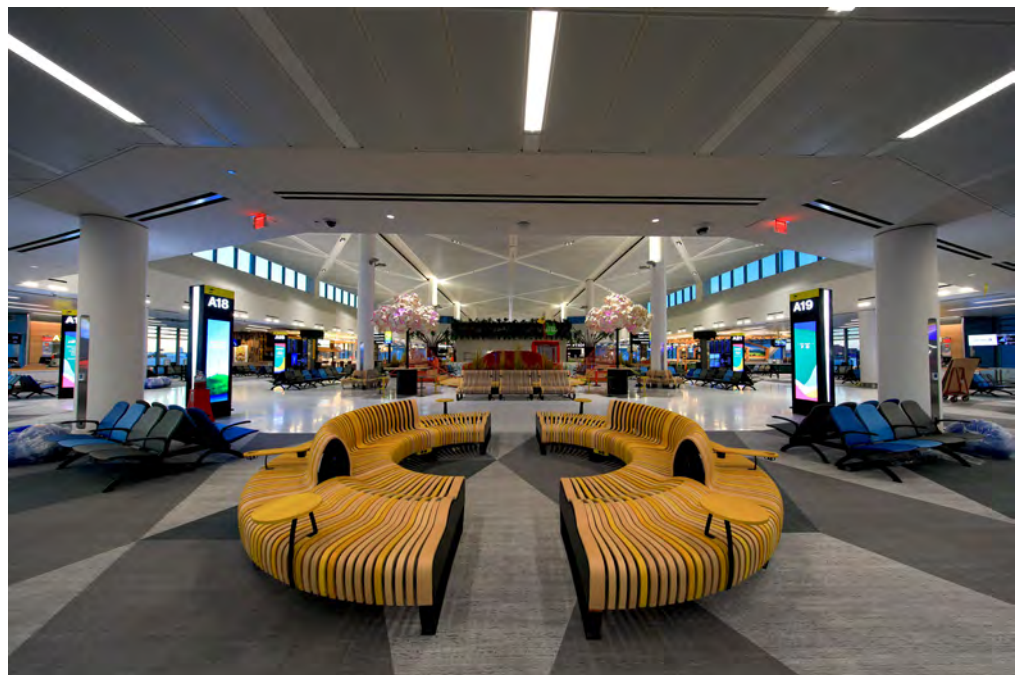


Image courtesy of PANYNJ

PROJECT DETAILS

Client

Syska Hennessey Group
Sergiu Pelau, PE, LEED AP
Principal
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Construction

Approx. \$7.4B

Project Start

2019

Project Completion

Est. 2025

Highlights

- + New 2.8 million SF terminal
- + 23 new gates
- + Arora was the lead EOR for the fire alarm and fire suppression engineering
- + On-site, full time project controls and project coordinator

PORT AUTHORITY OF NY & NJ (PANYNJ)

NEW TERMINAL ONE

John F. Kennedy International Airport (JFK), Queens, NY

Arora Engineers (Arora) provided professional engineering and project controls services to the Carisle Development team comprised of AECOM/Tishman/Walsh as the builder and PGAL as the team architect as a sub-consultant to Syska Hennessey Group for the construction of the new Terminal One at John F. Kennedy International Airport (JFK). The new Terminal One aimed to redefine international travel at JFK with 23 international gates, 22 of which were designed to accommodate larger, wide-body aircraft (FAA Airplane Design Group V or VI), and a total terminal area estimated at 2.8 million square feet. The new terminal contained approximately 24 security screening lanes, over 230,000 SF of retail, dining, and other concessions, 116,000 SF of airline lounges, and 55,000 SF of interior green space, children's play areas, and cultural exhibits.

Arora's scope of work related to the program's vertical structures for the New Terminal One at JFK. Arora provided fire alarm and fire protection engineering services in for the schematic design development, construction document, and construction administration phases.

Scope of work included:

The fire protection scope included definition design for fire protection systems to comply with applicable codes and standards. These systems included fire sprinkler, standpipe, and agent-based fire suppression systems, as well as standard wet and dry water-based sprinkler and standpipe systems. In addition, the scope included deluge sprinkler, pre-action sprinkler and gaseous suppression systems for high value or high challenge assets. The following tasks were included in the fire protection scope:

Design phase services were completed on time and within budget. Completed tasks during design development included contract drawings, specifications, cost benefit analysis, engineering calculations, and an estimate of probable construction costs. Arora also provided construction administration services to the PANYNJ including shop drawing review, field investigations, and responses to requests for information. Definition of applicable codes and standards, facility standards, and insurance carrier requirements.



**PORT AUTHORITY OF
NY & NJ**

NEW TERMINAL ONE

**JFK International
Airport, New York, NY**

- + Definition of fire protection design objectives based on project scope and code analysis.
- + Review of as-built drawings, equipment list, and inspection reports.
- + Identification of source of water supply.
- + Identification of size/location of existing fire protection systems.
- + Identification of hydraulic demand of existing fire protection systems.
- + Definition of hazard classifications and associated hydraulic design criteria.
- + Definition of special hazard fire protection systems.
- + Provision of locations for fire protection systems, fire protection water supply, fire protection areas/zones, and feed mains.
- + Provision of location of special hazard fire protection systems.
- + Indication of extent of demolition work.
- + Fire protection site plan indicating location/configuration of fire protection features.
- + System riser diagrams indicating major components.
- + Identification of temporary connections and service requirements to support construction phasing, including maintaining fire protection systems to existing T1 and T2.

The fire alarm scope included project definition design for fire alarm systems to comply with applicable codes and standards. The New Terminal One was protected throughout by a voice evacuation fire alarm system with automatic and manual fire detection as required by applicable codes and standards. The following tasks were included in the fire alarm scope:

- + Definition of applicable codes and standards, facility standards, and insurance carrier requirements.
- + Definition of fire alarm design objectives based on project scope and code analysis.
- + Review of as-built drawings, device list, and inspection reports.
- + Identification of make/model and location of existing fire alarm panels.
- + Identification of capacity of existing fire alarm panels.
- + Definition of where system signals were to be sent (onsite security/ops center, offsite security/ops center, fire department, Port Authority Police Department (PAPD) and Aviation Operation Center (AOC), third-party central station) and by what means (telephone utility, facility fiber network, radio, cellular).
- + Definition of mass notification objectives, and design of an MNS.
- + Identification of systems requiring input and output signal communication, including Fire Protection (FP), security, Audio Visual Systems (A/V), telecommunications, Public Address (PA), building management systems, baggage handling systems as well as Port Authority's 800 MHz NPSPAC public safety radio communication system.
- + Indication of location of fire alarm panels (head end, data gathering panels, remote power supplies, etc.), primary and emergency power circuits, fire alarm detection areas/zones, and fire alarm notification areas/zones.
- + Indication of the extent of demolition work through notes/narrative and existing device locations.

**PORT AUTHORITY OF
NY & NJ**

NEW TERMINAL ONE

**JFK International
Airport, New York, NY**

- + Provision of network diagram for multi-system networks.
- + Provision of system riser diagrams indicating major components.
- + Identification of tie-ins and coordination with Port Authority and NYFD fire alarm monitoring systems.
- + Identification of temporary connections and service requirements to support construction phasing include maintaining fire alarm systems to existing T1 and T2
- + Indication of the extent of demolition work through notes/narrative and existing device locations.
- + Provision of network diagram for multi-system networks.
- + Provision of system riser diagrams indicating major components.
- + Identification of tie-ins and coordination with Port Authority and NYFD fire alarm monitoring systems.
- + Identification of temporary connections and service requirements to support construction phasing include maintaining fire alarm systems to existing T1 and T2

Construction Administration (CA) services included submittal review, RFI's, and general CA services for the duration of the 56-month construction process. In addition to the traditional CA work of RFI's, submittal reviews, design punch lists, Arora's CA scope was intended to include 1.5 FTE's as on-site resident engineers for 36 months of the construction process.

Document Controls and Project Coordination: In addition to the design scope, Arora had a full-time on-site staff member performing document controls, and other project management and coordination services spanning the complete MEP systems design scope in support of the Syska Hennessy and Arora team

:

PROJECT DETAILS

Client

HOK
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Construction

\$4,200,000,000

Project Start

2015

Project Completion

2020

Highlights

- + P3 for 1.5 million square foot terminal
- + First airport project to receive LEED v4 Gold Certification
- + Fire alarm and suppression complete design scope
- + PS, Design Build Model
- + Despite the coronavirus pandemic hitting during the final five months of construction, the project was completed on time and on budget.

PORT AUTHORITY OF NEW YORK AND NEW JERSEY CENTRAL TERMINAL BUILDING

LaGuardia Airport, New York, NY

Arora Engineers (Arora) provided engineering services for the design/build of Terminal B at LaGuardia International Airport (LGA) as a member of one of the largest (public-private partnership) P3 teams in US history, LaGuardia Gateway Partners, made up of Vantage/HOK/PB/Skanska and others. The scope related to the Terminal Building portion of the project, which consisted of the Terminal Headhouse, Concourses A and B, West Garage Connector, Portal Building, and Central Heating and Refrigeration Plant (CHRP). Arora provided fire and life safety engineering and special systems peer review services as a subconsultant to the LaGuardia Gateway Partners Team with HOK and WSP as the lead design team.

LGA's new terminal was the first airport project to receive LEED v4 Gold Certification from the US Green Building Council. In addition to earning the LEED v4 Gold designation, the Terminal B redevelopment project was awarded the first Envision Platinum Award for commitment to sustainable practices and resiliency from the Institute for Sustainable Infrastructure (ISI) in 2019, the 2022 Design-Build Institute of America's National Award of Merit Winner in Aviation as well as the National Design-Build Project/Team award.

The new terminal is four stories in height and approximately 1,500,000 SF in area, and features elevated pedestrian skybridges leading to two concourses housing 35 gates. Most of the space in the CTB was classified as assembly due to the larger occupancy loads and included hold rooms, screening areas, restaurants, airline clubs, baggage claim areas, and arrival check-in areas. The remaining uses included business occupancies for offices, conference spaces with lower occupancy loads (i.e. not assembly) and airport operations; Mercantile Occupancies for retail spaces; and storage for miscellaneous storage and baggage handling areas.

One of the project's most distinct elements was a pair of pedestrian bridges that



Photo via Lester Ali

**PORT AUTHORITY OF
NEW YORK AND NEW
JERSEY**

**CENTRAL TERMINAL
BUILDING**

**LaGuardia Airport, New
York, NY**

spanned active taxi lanes and connected the newly opened arrivals and departures hall (also known as the headhouse) to the terminal's two concourses. The dual bridges allowed contractors to build over top of the existing terminal, which saved significant construction time and minimized impact to ongoing airport operations. Many considered the headhouse to be one of the most complex airport projects completed. The facility's large scale and small footprint combined with the need to build on top of an active operating terminal significantly increased the project's level of difficulty.

The design/build delivery methodology allowed the team to reduce the overall program schedule by 20% (2 years) compared to an earlier design/bid/build concept, and despite the coronavirus pandemic hitting during the final five months of construction, the project was completed on time and on budget.

Scope of work included:

Fire Protection Scope:

Arora provided designs for the CTB to be a fully sprinklered building consisting of a variety of protection systems due to the many hazards and conditions present. There were two dual connections for the fire protection systems. One dual system was used for the sprinkler systems. Electrical and Mechanical rooms are protected. All baggage and handling areas and other inaccessible areas such as above and below the conveying systems were also protected, and gaseous type suppression systems (eg. FM 200) were included for the control and data rooms, as well as deluge systems for protecting areas such as openings in fire resistance rated walls and along exterior glazed walls to protect the bridges and connectors.

Fire Alarm Scope:

Arora provided a comprehensive fire alarm and detection system throughout the CTB. The systems included control panels, sub panels, annunciators and associated equipment, wire, and conduit to provide a fully addressable fire alarm system. Arora laid out all smoke detectors, heat detectors, duct smoke detectors, pull stations, monitor modules, relay modules, horn, strobes, and all other field devices pertaining



Photo via Gov. Andrew Cuomo's Office

PORT AUTHORITY OF NEW YORK AND NEW JERSEY

CENTRAL TERMINAL BUILDING

LaGuardia Airport, New
York, NY

to the fire alarm system. The system was multi-faceted and interconnected with the fire/life safety, HVAC, smoke management, smoke purge systems, elevator recall, escalator, baggage conveying system, and atrium smoke control.

The supervised fire alarm signal system was a pre-signal system and incorporated an emergency voice/communications system in accordance with NFPA 72. This system was designed for intelligibility throughout the concourses and hold rooms. Visual notification devices were provided throughout. The system design was a Positive Alarm Sequence in accordance with NFPA 72 to minimize false alarms and the evacuation of occupants in and out of secure spaces. This sequence, with specific requirements, allowed for an initial investigation prior to evacuation the building. The fire alarm system tied into the existing PANYNJ fire optic ring and provided notification to the PANYNJ Wide Area Network at each MDF demarcation.

Special Systems Scope:

Design peer reviews for the following systems:

- + Structured cabling
- + Network (LAN&PAWANET)
- + Airport operational systems (AODB, AOS, EVIDS, Etc.)
- + Security
- + Public address

Construction During Coronavirus:

A portion of the project was nearing completion in mid-March when COVID-19 struck New York City. This project was deemed essential by state officials, and therefore the mandate was to continue working. New protocols and practices were implemented regarding safe distancing, face coverings, hand washing, cleaning and other safety measures. LaGuardia Gateway Partners put numerous measures in place at the new facility to enhance safety for passengers and airport workers. With the safety measures in place, the project was completed on time and on budget with a nearly perfect safety record.



Photo via Gov. Andrew Cuomo's Office

PROJECT DETAILS

Client

City of Philadelphia
Division of Aviation
Jim Jones, PE
Project Manager
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Construction

\$150,000,000

Project Start

2008

Project Completion

2013 (Hub)
2015 (Bag claim & ticketing)

Highlights

- + Project included 86,000 SF of new floor space and a baggage claim building
- + Provided MEP, fire protection, and security/special systems engineering
- + Responsible for construction administration support and inter-agency coordination

CITY OF PHILADELPHIA, DIVISION OF AVIATION TERMINAL F HUB EXPANSION

Philadelphia International Airport, Philadelphia, PA

Arora Engineers (Arora) provided design for the mechanical, plumbing, fire protection, fire detection, electrical, special systems, and security engineering services for an expansion of Terminal F at the Philadelphia International Airport. Improvements involved approximately 88,400 SF of new floor space, a new baggage claim building, additions and modifications to the existing building, new architectural finishes, and systems upgrades. Terminal F has three concourses connected by a central hub, 38 gate positions, a ticketing building, a baggage claim, and a skybridge leading to the parking structure.

Scope of work included:

- + Electrical: Power distribution; lighting design and controls, power ductbank design, motor control panel, substation modification and analysis, and concession space low voltage power.
- + Mechanical: Study of future cooling and heating capacity, satellite thermal plant expansion systems, including pumps and pipelines, domestic water piping, sanitary and stormwater design, and gas piping modifications required.
- + Fire/Life Safety: code review; fire alarm and detection system, clean agent suppression (Fm 200 or other), fire sprinkler systems (wet, dry, pre-action), hydrant and hose reel systems, and fire egress interfaces.
- + Special Systems/Security: Multi-use flight information displays, visual paging advertising/wayfinding, network architecture (Mac minis, cat 6 Cabling, upgrade G4 Platform), horizontal structured cabling design, access control and intrusion detection, access control doors, CCTV, digital video recording, TACS, ambient noise sensing and automatic compensation, amplification of Live Speech announcements originating at microphone stations, UCDS, and MDF/IDF analysis and design.

Arora also provided construction administration support and inter-agency coordination. With this expansion, the airport hoped to create a better passenger experience and generate additional concession sales by expanding available space and improving retail options.



PROJECT DETAILS

Client

Henry Campbell
Airport Operations Security
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Henry.Campbell@rdu.com

Project Start

2015

Project Completion

Ongoing

Highlights

- + On-call / task-order-type contract
- + Special systems engineering included CCTV, access control, public address, and data
- + Security consulting services
- + Design and construction administration services

RALEIGH-DURHAM AIRPORT AUTHORITY

ARCHITECTURE AND BUILDING ENGINEERING SERVICES

Raleigh-Durham International Airport, Morrisville, NC

Arora Engineers (Arora) was selected as part of the team tasked with providing on-call architecture and building engineering services at Raleigh-Durham International Airport. The contract's scope of work included architectural, engineering, and other related professional services, such as condition assessments, facility investigations, planning, design, construction administration, project representation, and program management services for new construction, repair, renovation, and maintenance of various building facilities at the airport.

Task 1

As part of a space utilization study conducted by Gensler, Arora was tasked with providing special systems and security consulting services related to the building hardening of employment locations at Raleigh-Durham International Airport (RDU), including the Airport Operations Center, Maintenance Facility, and RDU Center.

Task 2

Arora provided DD to CD special systems engineering for the renovation of the ticketing and concourse areas of Gate A1 through A4 of Terminal 1. This renovation provided new check-in and baggage screening facilities on level one with revised Back of House areas for ATO offices and other facilities. The concourse level area was renovated to provide full activation of gates A1-A4, including the relocation of two passenger boarding bridges. A CUTE system was utilized on both levels to facilitate use by multiple airlines.

Task 3

Construction Administration for Gate A1 through A4 of Terminal 1 in which Arora provided security and special systems design for the concourse and ticketing area renovations to restore service to four gates and associated hold rooms, passenger processing, and baggage screening. Systems included public address and security



**RALEIGH–DURHAM
AIRPORT AUTHORITY**

**ARCHITECTURE
AND BUILDING
ENGINEERING
SERVICES**

**Raleigh–Durham
International Airport,
Morrisville, NC**

(access control and CCTV). Arora also accounted for the required security devices for jet bridges and baggage screening as well as any additional CCTV coverage required in the ticketing area to accommodate RDU's security plan and the modifications. Arora also provided construction administration services for this task.

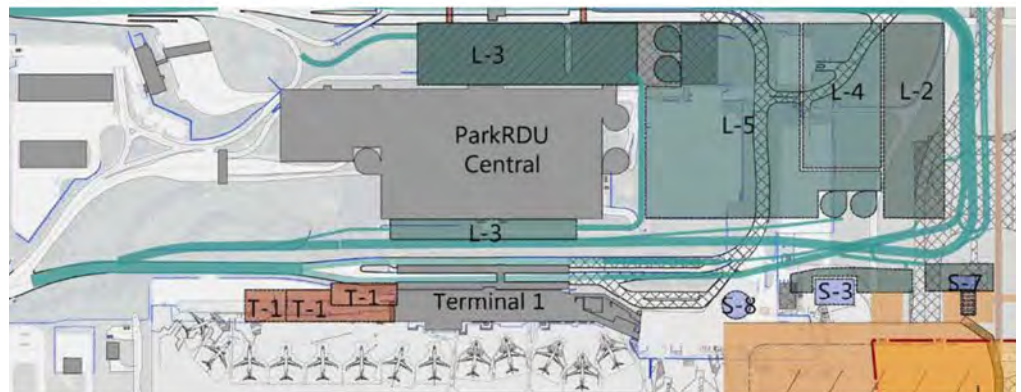
Task 4

Arora was requested to conduct an on-site survey of Terminal 1 to assess the existing conditions in preparation for the four-gate expansion project. Arora's specific scope included the expansion of the CCTV, access control and public address systems in this area as well as any required modifications to the curbside, security screening, bag claim, and concessions area due to this project. Arora verified that there was adequate infrastructure to support the implementation and expansion of these systems. If the infrastructure did not exist, Arora made recommendations on how to implement the expansion. Through the site visit, a review of existing and current record documents, an evaluation of the latest Master Plan updates, and meetings with the authority management and staff, Southwest Airlines, other impacted airlines, and the Transportation Security Administration (TSA), Arora delivered an engineering system narrative with drawing diagrams indicating impacts on the systems directly related to Arora's scope of work.

Terminal 1 Four-Gate Activation



Terminal 1: Four Gate Expansion



PROJECT DETAILS

Client

Atkins
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com
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Construction

\$184 million

Project Start

2018

Project Completion

Est. 2024

Highlights

- + Arora was responsible for reviewing mechanical, electrical, plumbing, special systems, security, life safety, and civil disciplines
- + Utilized Bluebeam for interactive review

LEE COUNTY PORT AUTHORITY

TERMINAL EXPANSION DESIGN

Southwest Florida International Airport (RSW), Fort Meyers, FL

Arora Engineers (Arora) provided professional peer review and quality control services to the Atkins team responsible for improvements at the terminal building and concourse areas at Southwest Florida International Airport (RSW).

The project consisted of a multi-story expansion of the existing terminal's north face along its entire length between the current checkpoint queues of concourses B and D. The expansion of the building's footprint extended northward into Concourse C past the existing ramp and security checkpoint. When completed, the expansion consolidated the airport's three checkpoints into one and provided for new concession and retail spaces and upgrades to the building's infrastructure and MEP systems. Also included was a remote loading dock and renovations and improvements to TSA administration space and non-public airport administration spaces. The total area of expansion and renovation was more than 300,000 square feet.

The project comprised renovations and expansion in the Terminal, Concourses A, B, C, and D, and the Terminal Apron, with services including removal and relocation of central elevator and stair access/egress to all levels, including relocation of associated building system equipment and piping; rework of structural, mechanical, electrical, plumbing, fire protection, and special systems necessary to implement the design, addition of new signage, and wayfinding.

Arora was selected to provide a peer review for mechanical, electrical, plumbing, special systems, security, life safety and civil disciplines.

Scope of work included:

Arora coordinated their review with the Atkins Project Team to provide a five-step, phase-specific bluebeam-based interactive review of the following:

- + Review of record drawings
- + Review and provide comments for mechanical, electrical, plumbing, special systems, security, life safety, and civil disciplines
- + Review and provide comments on technical specifications
- + Review, cross check, and provide comments on bid schedules
- + Review applicable calculations
- + Review of baggage handling equipment as it relates to Arora disciplines
- + Review of concession utility analysis
- + Review of LCPA Tenant Design Criteria Manual
- + Review of final design criteria report
- + Review of descriptive materials prior to presentations to RSW

LEE COUNTY PORT
AUTHORITY

**TERMINAL
EXPANSION DESIGN**

Southwest Florida
International Airport
(RSW), Fort Meyers, FL

PROJECT DETAILS

Client

San Jose International Airport
Kirk Ruffo, AIA
Director of Planning
Planning & Development
Division
1701 Airport Boulevard
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(408) 392-3600

Construction

Varies by Task

Fee

\$215,479

Project Start

2018

Project Completion

2023

Highlights

- + Mechanical, Electrical, Plumbing, Fire/Life Safety, Special Systems, Airfield Electrical and Geospatial consulting services on an on-call basis
- + Expert engineering services in relation to the update of the Design and Construction Guideline criteria utilized for Airport Landside projects
- + MEP/FLS/SS engineering services for ADA Accessibility enhancements throughout the existing Terminals and other airport facilities

CITY OF SAN JOSE

ON-CALL ARCHITECTURAL AND ENGINEERING CONSULTING SERVICES

Norman Y. Mineta San Jose International Airport, San Jose, CA

Arora Engineers (Arora) served as subconsultant on the Jviation, Inc. team, providing on-call consulting engineering services at Norman Y. Mineta San Jose International Airport. Engineering and Architectural services were required for a number of crucial assignments throughout the airport such as terminal improvements and modifications, maintenance, rehabilitation, design of new and existing airfield, roadway, and parking pavements, and assisting airport staff with the implementation of the airport's CIP. All work was performed in compliance with appropriate FAA Advisory Circulars.

Task Order 1 - Concession Tenants Improvements Design Criteria Documentation:

Arora provided Mechanical, Electrical, Plumbing, Fire Life Safety and Special Systems engineering services related to the preparation of an updated design guideline document incorporating stakeholders' upgrades to the criteria. These new guidelines and parameters can be applied to any tenant concession design and construction project within the boundaries of the Airport Terminal Building. Reviewed existing documents and gathered preliminary information.



Norman Y. Mineta San Jose International Airport

Arora's scope of services for this task order included:

- + One Vision workshop, along with technical support and input.
- + Coordinated upgrade goals per specific stakeholders.
- + Weekly conference calls and four on-site meetings with the city attended by the project manager or project engineer.

CITY OF SAN JOSE

ON-CALL ARCHITECTURAL AND ENGINEERING CONSULTING SERVICES

Norman Y.
Mineta San Jose
International
Airport, San Jose,
CA

Task Order 2 - ADA Accessibility Upgrades:

Arora provided mechanical, electrical, plumbing, fire life safety and special systems engineering services to enhance accessibility of the existing facilities to meet the latest codes, federal regulations, and standards. This project included upgrades throughout the public areas of the airport including Terminals A, A+, B, FIS, Airport Operations, Administration Parking Lot, and Garage A & B. Arora's scope of services for this task order included construction documents and construction administration of all enhancements for this four-year project.

Task Order 3 - Restroom Upgrades:

Arora provided mechanical, electrical, and plumbing engineering services for the redesign of plumbing and associated electrical for four existing restrooms at SJC. Arora's services included plans, specifications and services for preliminary construction documents, construction/permitting documents, and bid phase and construction administration.

Task Order 4 - Alaska Airlines Touchless Self Bag Drop Pilot:

Arora performed electrical and special systems engineering services for a Self-Bag Drop Pilot for Alaska Airlines at SJC. In the wake of the COVID-19 pandemic, Alaska Airline opted to test a Self-Bag Drop option for passengers seeking a more efficient, contactless baggage check experience. The airline implemented a state-of-the-art Materna Dual Station Self Bag Drop—the first of its kind implemented in the US.

Arora provided electrical and special systems engineering design services for the for the demolition/salvage of two ticket counters and the addition of a Materna Dual Station Self Bag Drop. Arora also provided engineering services for the schematic design and basis of design development, construction documents, and construction administration phases of this fast-tracked, two-month project aimed to be completed by July of 2021.

Task Order 5 - West GA Hangar Electrical System Analysis:

Arora was responsible for electrical and special systems engineering services to provide an analysis, report, and ROMs for electrical upgrades for the GA West Hangars.

- + ROM #1 detailed the necessary upgrades to upgrade the existing system enough to meet code compliance / stands to allow the existing system to function.
- + ROM #2 detailed the necessary upgrades to increase capacity to accommodate additional equipment on the tenants' equipment wish lists.

Services included:

- + On-site meetings.
- + On-site walk through survey of existing visible conditions.
- + Analysis report.
- + GA hangar upgrade information to support ROM cost estimates.

Rethinking Infrastructure®



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