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New Satellite Concourse Provides Efficient Gate Expansion at Nashville Int'l

BY KRISTEN RINDFLEISCH

To accommodate increased passenger demand, Nashville International Airport® (BNA®) recently constructed a standalone Satellite Concourse adjacent to its main terminal. The 89,000-square-foot structure opened in October 2023 and now houses operations primarily for Allegiant Air and Spirit Airlines. With eight common-use gates (and space for a ninth), the airport's fifth major concourse not only increases capacity but also facilitates the future expansion of Concourse A. Electric shuttles transport passengers between a station in Concourse C and the new Satellite Concourse—a distance of a mere 1,200 feet.


DOUG KREULEN

For the past 11 years, BNA has been growing at an average of 10% per year. "You always want to make sure you have that ability to continue to expand to meet your passenger needs and airline needs," remarks Doug Kreulen, president and chief executive officer of the Metropolitan Nashville Airport Authority, which owns and operates BNA. "We didn't want the infrastructure to slow down the growth, so we knew that we needed to find a way to get eight extra gates."

The airport partnered with Holder Construction as prime contractor for its $134.5 million Satellite Concourse project. Holder rounded out the design-build team with Corgan as lead architect and Gresham Smith for architecture support and lead structural engineer. All three firms have long, established relationships from collaborating on other airport projects. Corgan had already gained institutional


PHOTO: AERIAL INNOVATIONS SOUTHEAST

knowledge by working as master architect on projects for the BNA® Vision expansion and renovation plan. "I felt like that was very invaluable and we basically just hit the ground running, like 80 miles an hour, from Day One," remarks Richard Fielding, vice president at Holder Construction and project executive for the design-build team.


RICHARD FIELDING

"They were good partners with us, and it was a real pleasure to work with them through this project," says Kreulen.

Where to Begin

Planners added the new Satellite Concourse off the end of Concourse C because the airport could not expand concourses A or B quickly enough, and Concourse D was already being remodeled. Airport officials agreed that building a standalone concourse near the sparsely used Taxiway J would be faster

BNA® Nashville International Airport®

FACTS&FIGURES

Project: Satellite Concourse

Location: Nashville (TN) Int'l Airport

Size: 89,000 sq. ft.

Cost: $134.5 million

Funding: Airport revenue bonds; $33.18 million from state of Tennessee

Construction: Utility work Dec. 2021–May 2022; building work May 2022–Sept. 2023

Key Components: 8 common-use gates (with space for 9th); electric shuttles to/from main terminal; concessions

Delivery Method: Design-Build

Prime Contractor: Holder Construction

Lead Architect: Corgan

Architectural Support, Lead Structural Engineer, Experiential Design & Wayfinding: Gresham Smith

Structural Design: Logan Patri

Civil Engineering: Garver; Shrewsberry; Foth

Mechanical, Electrical, Plumbing & Fire Protection Engineering: I. C. Thomasson Associates Inc.; DF&H

Special Systems, Low Voltage, IT Engineering & Construction: Arora Engineers

Life Safety: WJE

Fueling Design: Argus

Hydrant Fuel System Installation, Testing, Flushing & Commissioning: KEAR

Management Support: TRTH Consulting

Geotechnical: KS Ware

Surveying: CIA

Disadvantaged Business Enterprise Consulting: Alliance Synergy

Construction Management: Pillars

Scheduling: Connico

Project Management & Augmentation to BNA Engineering Dept.: WSP

Ramp Control: Saab Sensis

Electric Shuttle Fleet Owner & Operator: ABM

Electric Shuttle Manufacturer: Cobus

Gate Information Displays: Engage Series direct-view LEDs, by Nanolumens

Holdroom Seating: Kusch+Co

Jet Bridges: ThyssenKrupp

Key Benefits: Increased capacity to handle passenger growth; satellite format facilitated fast, cost-effective construction

and more efficient than other traditional concourse expansion options.


MATT KOSS

"Locating the concourse to work best with Taxiways T4 and T6 on either end of the project was vital," explains Matt Koss, aviation team leader with Garver. "Airport Authority staff maintained a long-term view of the area knowing that additional apron expansions would be occurring."

Determining how to move passengers between Concourse C and the Satellite Concourse was another matter. Digging a tunnel through underground rock was considered a la Hartsfield-Jackson Atlanta International, as was an aerial walkway, like at Seattle-Tacoma International. But all were pricier and more time-consuming than using electric shuttles. "You could build bridges, you could dig tunnels, but the cost of those could have been more than the actual building itself," Fielding remarks.

Electric shuttles transport passengers to and from the new Satellite Concourse.

The Fleet

Nine electric COBUS 2700S shuttles serve the Satellite Concourse. The $8 million fleet runs 24 hours a day, every three minutes, with room for 69 passengers on each vehicle. The airport typically operates five shuttles, but can scale up to eight during holidays or peak travel periods and still have a spare in reserve. The shuttles charge at a rate of 1kW per minute on four embedded charging stations adjacent to the drive lane at the Satellite Concourse. They can achieve a 25% charge in 30 minutes, depending on weather conditions. (Vehicles charge more slowly in cold weather.)

ABM manages the airport's landside and airside shuttle operations. This includes planning, specifying shuttle configuration and technology features, staffing, vehicle maintenance, fueling/charging and passenger assist services. The company will also maintain the charging stations. "ABM is pleased to work with BNA to help accommodate its exponential growth while enhancing the passenger experience," says Paul Harvey, senior general manager of Aviation for ABM. Early this year, the company also began a seven-year contract for landside bus operations at the airport.

The move to electric shuttles supports BNA's environmental goals. Years ago, the airport had low-sulfur diesel buses, which were later replaced with compressed natural gas. Now, the electric fleet for the Satellite Concourse is completely carbon dioxide–free.

Beyond the sustainability benefits, the electric shuttles create less noise and no fumes for passengers. "This model offers perceptible noise reduction along with a smooth start and operation for a quiet, comfortable ride," says Harvey. "The low floor also offers easy access with no stairs needed."

Passenger feedback since the soft launch last fall has included:

- "I like the overall convenience."
- "It's easy to get in and out."
- "Very quiet compared to diesel buses."

The shuttles have Siemens Elfa electric powertrains designed for high reliability and low maintenance. Technology features include internal and external cameras for security, systems that monitor driver behavior, automated waypoint announcements, GPS to track shuttle movement and ensure ABM is meeting the required headways for the passenger experience and an onboard video system the airport uses to welcome passengers to and from the Satellite Concourse.

The 1,200-foot journey between Concourse C and the Satellite Concourse takes less than three minutes, and passengers are treated to interesting views in both directions. "You really do get a front-row seat to what's happening in and outside the airport," Kreulen remarks. "Flights for concourse D and C are taxiing right by the Satellite on a daily basis. So, you really get that thrill of aviation."

ABM applied its institutional knowledge from integrating electric shuttles at other major airports to smooth the transition for BNA. "From an operational standpoint, this implementation went remarkably smooth," Harvey reports. "COBUS is a pioneer in airport mobility and offered exceptional support throughout the entire process."

ABM expects more airports to follow BNA's lead and embrace electric shuttles. "Many are already mapping out transition strategies," says Harvey. "As more clean transportation options evolve—whether

battery-electric bus or fuel-cell electric bus technology—we believe the next five years will see most airports embrace electrified fleets."

Intentional Design


ROSS PAYTON

The Satellite Concourse was designed following best practices for environmentalism and the high-performance building goals established within BNA® Vision. The team at Corgan considers sustainability to be innate within its work. "Our general approach on sustainability is not to think of it as an add-on or an option, but it's really inherent in our base decision-making and good design," explains Ross Payton, Corgan's principal-in-charge for the BNA projects.

Sustainable materials and regionally sourced materials were used, and the building was designed to be energy efficient with water-conserving plumbing fixtures; energy-efficient lighting; light-colored building and paving materials that retain less heat, and thus reduce energy use for climate control and mitigate the heat-island effect; and strategically placed recycling receptacles throughout the concourse.

Airport officials wanted to create "experiential continuity" between the main terminal and Satellite Concourse, so designers worked to create the same tone and feel. "We wanted to continue that warm and welcoming climate that Tennessee offers to all travelers," Kreulen comments.

That translated to airy spaces with sweeping views through large windows at all eight gates. "You get so much natural daylight into this space, and we went with an open structure," Fielding notes. "It's very open feeling, kind of modern and clean looking, with an awesome view."

Passenger-Friendly Features


DAVID PARK

The design-build teams put a lot of thought into the passenger flow at the shuttle station. As passengers enter the station from the terminal concourse, they have a clear sight line to their destination. The elevators open to the main path of travel for those entering the station, and then open up on the opposite side of the cab on the lower level, giving passenger direct visual access to the shuttles. "You're always moving in the direction of travel that you desire," notes David Park, senior environmental graphic designer with Gresham Smith.

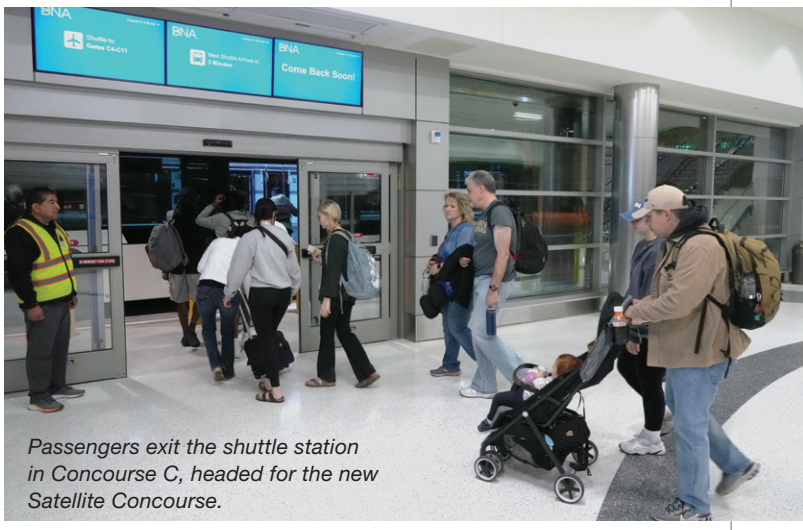
Once inside the Satellite Concourse, passengers do not have any stairs, elevators or escalators to contend with. The

design-build team realized it would be more efficient and cost-effective without vertical transportation systems delivering passengers to/from the apron level. To achieve this, the team designed a road and ramp structure that aligns with the main floor of the concourse and jet bridges. The shuttles drive up the ramp to the drop-off point, and travelers exit the shuttle directly on the main floor, with no need to find vertical transportation to reach their gates. “That just saves a lot of area that would otherwise have been used for vertical circulation, so it’s a big cost savings,” explains Matt Amos, senior architect with Gresham Smith. “And at the end of the day, it’s also a much better passenger experience because they are being dropped off at the right level.”

MATTHEW AMOS

It’s a curb-less curbside of sorts: extended canopies over the loading/unloading areas and flush curb-to-roadway transitions further enhance the customer experience and safety. Passengers do not have to brave the elements to board their plane, as some satellite concourses require. “We wanted to make sure it was customer-convenient and comfortable,” Kreulen emphasizes.

Amenities and concessions were crucial to prevent passengers from feeling like they are relegated to a remote facility. BNA incorporated a variety of food, beverage and retail options; and the holdrooms are nearly identical to those in the main terminal. “It is a seamless extension of the main terminal from a passenger experience and amenity perspective,” says Joel Efrussy, Corgan’s lead architectural designer for BNA® Vision projects.



Passengers exit the shuttle station in Concourse C, headed for the new Satellite Concourse.

The main terminal shuttle station and satellite concourse are staffed with attendants to guide flow and offer extra assistance

JOEL EFRUSSY

Satellite Concourse gates were numbered to minimize the need for signage changes elsewhere in the airport.

to travelers. For instance, attendants deploy ramps to help passengers with mobility challenges enter and exit the shuttles.

Retail options include the Distillery District Market, with bottled Tennessee spirits; Gulch Goods, featuring local artisans and travel items; and Nashville Supply Co. for local products and convenience items. Food and beverage concessions include Bongo Java coffeehouse, providing coffee and breakfast selections; TX/MX, a TexMex restaurant that serves breakfast, lunch and dinner; Jimmy John's sandwich shop; and Fat Bottom Brewery, a table-service restaurant with live music.

Renumbered Gates, Updated Wayfinding

With the removal of one gate and the addition of eight new ones, BNA and the design-build team studied other airports with satellite concourses to see how they handled wayfinding. Multiple strategies were considered, and designers weighed the number of signs, static maps and digital directories throughout the airport that would be affected by each renaming/renumbering option.

The first scenario entailed naming gates in the Satellite Concourse Gates X1 to X8, but that would have required BNA to update wayfinding signage throughout all of its other concourses. A second option would have continued the Concourse C gate numbering, which ends at C25. That would have made the Satellite Concourse gates C26 to C33. The fear with this option was that passengers getting dropped off at the shuttle station near Gate C6 would naturally keep walking to the end of the C Concourse to find Gates C26 to C33. Yet another option was to

name the Satellite Concourse gates C6A through C6H since the shuttle station would be at C6 gate; but the additional sub-letter was deemed too confusing.

Gresham Smith devised the system that was ultimately adopted: renumbering Concourse C to include the new contiguous gates in the Satellite Concourse. That only affected numbering and signage in Concourse C. All the other Concourses remained unchanged. The shuttle station was built at the former Gate C6, so the Satellite Concourse gates are numbered C4 through C11 (with C12 on hold as the potential ninth gate). The location of the shuttle station combined with the numbering logic is intended to provide passengers with a relatively easy route to their gates and minimize confusion. "When travelers trying to reach one of those gates walks past the shuttle station entrance and are met by gate C13, they'll instinctively know they've gone too far," Park explains. Signage for the shuttle station also lists the range of Gates C4 to C11. "That particular approach required very few changes to existing signage in the airport, so it's a win-win," he comments.

Because BNA had documentation for all of its existing sign types and details, Gresham Smith had a blueprint when creating signage and wayfinding for the Satellite Concourse.

Unique Security Needs

Because BNA's Satellite Concourse is a freestanding building with no direct connection to the main terminal, it requires more security measures than a traditional satellite concourse that is connected via tunnel or skywalk. Arora Engineers and Holder Construction helped the airport design and install a TSA-approved system with in-ground photo beams to detect intrusions and an access control system for the doors that lead to the shuttle boarding area. The systems work together to allow passengers to exit outside only when a shuttle is at the boarding station.

When a shuttle arrives, the underground photo beam sensors in that area are disarmed, sliding doors open, the motion detector at the sliding doors is enabled and the digital signage at the doors displays the message "Now Boarding" to let passengers know they are allowed to walk out and board the shuttle. If there is no shuttle at the station, the sliding doors remain locked and the photo beam sensors will trigger an alarm if anyone enters the area. BNA also has security staff on duty 24 hours a day at the shuttle station and the Satellite Concourse entrance for additional support.

Arora Engineers designed the special systems such as public address, common-use passenger processing, electronic video information display, video surveillance and access control

A full concessions lineup provides passengers with a "main terminal" experience.

systems, as well as telecommunications backbone and horizontal cabling and infrastructure. To accommodate construction of the Satellite Concourse, the firm also planned the relocation of an existing perimeter intrusion detection system (PIDS) in seven phases to ensure there was coverage at all times. Temporary dual-technology sensors were installed, and a new stand-alone solar power and wireless comms were established as a temporary source to support continued operation of the PIDS throughout construction until permanent power and data connections were made at the new Satellite Concourse. Fiberoptic backbone cabling was extended from the main terminal to the new building to serve all the special systems as an extension of existing systems at main terminal. To accomplish this, a new underground duct bank with sufficient capacity for the new cabling was installed, and part of the existing underground duct bank was also used.

"We added multi-cell fabric inner duct to run the new fiberoptic cables, which allows us to meet the current needs of the project but also gives the airport future

pathways for their future needs," explains Sheeba Money, Special Systems project lead with Arora Engineers.


SHEEBA MONEY

Overcoming Challenges

Meeting the aggressive design and construction schedule was no easy task for the project teams. "Challenge number one was coming up with a game plan that they could support," says Fielding. Staffing was another challenge because there were several other large projects happening around Nashville at the same time and not enough local subcontractors to execute them. Fielding describes the situation as the perfect storm. "It ended up being a constant battle for us to just make sure we had people there to work and build the project every day," he recalls.

To minimize operational disruptions, BNA only allowed the project teams to close one taxi lane at a time. So, with the aggressive timeline, planners had to be very strategic about how they phased the project. Construction on the building itself could not begin until all the utilities were installed (fiber cabling, telecom, electrical, water, sewer and stormwater), and that took about five months.

Crews also had to connect the new concourse to BNA's hydrant fuel system. Argus designed the new fuel lines, and KEAR installed them. Careful planning and tactical sequencing were required to dig and install the new lines while arrivals and departures continued to taxi through the same area.

In addition to fuel and utilities, the Satellite Concourse also needs a steady stream of food, drinks and retail inventory for passengers. Delivery docks and a freight elevator supply concessionaires with their goods, and associated refuse is exported via trash docks. "I'm thankful that Corgan, Holder and Gresham Smith were able to help think that through," says Kreulen.

Like almost all recent construction projects, BNA's Satellite Concourse was impacted by pandemic-related supply chain issues. The long lead time on steel bar joists for the roof posed significant challenges. So early in the process, Gresham Smith worked with Holder Construction to find a work-around. By switching the design to use steel beams, they were able to recapture four to five months for

the construction schedule. The steel beams were heavier and slightly more costly but also more readily available. “The design-build approach—being integrated with [Holder] early on in the design—really helped us tailor the product to the supply chain issues and helped them deliver the construction schedule at the pace that we needed to,” explains Andrew Dial, structural engineer with Gresham Smith.


ANDREW DIAL

With airfield on all four sides of the Satellite Concourse, building pavements within FAA slope tolerances was another notable challenge. Garver used an iterative process to select an elevation for the building that required the least amount of demolition and reconstruction.

Creating the curbless curbside entry to the precast ramp required engineering finesse in and of itself. It also required collaboration among various teams to provide adequate clearance for shuttles to travel under the pedestrian walkway, which is at the same level as the main concourse, at the shuttle station in Concourse C. “Obviously, those are different buildings from a structural perspective,” says Dial. “So, we had to make sure that we detailed and designed how that walkway comes over to meet the ramp—and in a way that made it easy for the contractor to make those two systems meet up together out in the field.”

The shuttle station at Concourse C also required a creative design. The design team was tasked with managing pedestrian flow and shuttle turnaround within the confines of a space that previously housed a single aircraft gate. The station had to be built, and subsequently operate, directly adjacent to active aircraft. Designers connected the shuttle station to the main terminal with an overhead pedestrian bridge. The bridge is at the same level of the concourse for passenger convenience, while shuttles circulate beneath. At the ground-level station, arriving passengers unload on one side and departing passengers board on the other to minimize congestion.

Compared to the engineering and construction challenges, logistics regarding delivery of the shuttles from Europe seemed minor. The vehicles were transported to Charleston, SC, via boat and then trucked to the airport in Nashville—about a five-week journey in total. BNA received delivery of the shuttles in mid-September 2023 so drivers could learn charging procedures and begin practicing their routes before the Satellite Concourse opened that October.

Opportunities

With the new Satellite Concourse and shuttle fleet comes an increase in the BNA workforce. There are about 50 employees to operate and maintain the shuttles, 20 customer service representatives in the shuttle station and concourse, plus other workers at the seven businesses that operate in the concourse. “Overall, not even counting construction, there are probably 250 to 300 people that work, day in and day out, to keep the Satellite Concourse alive and well,” Kreulen remarks.

By incorporating the shuttle station into a single gate position, the BNA team only eliminated one gate to facilitate adding eight more at a separate facility. Personnel from Gresham Smith think that this is a solution other airports may want to consider, but the approach requires early discussions about passenger security and safety. “We don’t want passengers standing out on that curbside, having the ability to run off to an aircraft,” Amos emphasizes. “Get your special systems team involved and coming up with a physical solution to handle that crowd control, keeping the airport safe and secure while you’ve got all these people moving around on the airside.”

Flat curbsides and shuttles with low floors ease transitions for passengers.

At BNA, placing the shuttle station at the former Gate C6 position helps orient passengers throughout their journey between the main terminal and Satellite Concourse. “You’re always visually connected to the environment around you,” explains Payton, from Corgan. “You have the natural light, you have all the aircraft, all the different activities that happen at the airport; so you’re always connected to what’s going on around you.”

Advice for Others

Kreulen urges any airport considering a satellite concourse project to connect with other airports that have already completed one. “You’ve got to build it so it’s easy for passengers to get over there,” he cautions. “You’ve got to build it for the airlines to be able to operate there.”

At BNA, constructing a satellite concourse rather than expanding the main terminal allowed officials to add gates quickly with minimal disruption to the rest of the airport.

The financial implications were also attractive. Fielding, from Holder Construction, estimates that BNA’s new Satellite Concourse cost about $13.5 million to $14 million per gate. “I would say they got a lot for their money,” he reflects. “From our perspective, they got a really nice facility for a very, very low cost compared to most concourse builds.”

Efrussy, from Corgan, notes that BNA’s master planning process was key. “The entire satellite shuttle concept was thought about very, very early on, so we were able to work that into the initial planning stages quite early in the process,” he explains.

Frequent, open communication proved invaluable as well. For the first nine months, work focused on programming and design, with weekly calls involving BNA and all the stakeholders, from design, engineering and construction to operations and concessions. Additionally, internal design-build teams held coordination meetings to continue collecting information from the airport for their design packages. “It was a very intense nine months because we had to design so much work so quickly to get started,” Fielding recalls.

Holder conducted monthly presentations for senior executives at BNA to prompt key decisions and keep the project on schedule. Once construction began, the schedule increased to weekly meetings.

Working with collaborative partners was crucial, adds Payton, from Corgan. He credits Holder for including all the right people at the right times, and for facilitating design charettes and programming meetings. “In design-build, as you’re going through the design process, they can—almost in real time—align the budget with the airport’s goals and objectives,” Payton explains.

Because satellite concourses are often built to relieve congestion quickly, they typically have tight design and construction schedules. That requires key partners to work together efficiently and effectively. “The biggest part is just having an overall group of companies and design teams and contractors that are really dedicated to working well together and making sure they’re talking to each other, collaborating well and working hard to get all of it turned around—not just quickly, but done well at the same time,” remarks Dial, from Gresham Smith.

Every airport project is unique and challenging for different reasons, Fielding adds. “Aviation work is not for the faint of heart,” he remarks. “The key is getting that collaboration and team environment very early in the job, and we were lucky to be able to do that.”

He cautions other airports not to underestimate the challenges of building a satellite concourse, because the process can require significant infrastructure work and constant coordination and communication.

Coming Up

Early this year, the BNA® Vision program came to a close. Major projects included the International Arrivals Facility, Concourse D expansion, Grand Lobby, Terminal Parking Garage expansion, the Satellite Concourse and on-site Hilton BNA Hotel.

The next construction and renovation program, New Horizon, began in early 2022. It includes the expansion of Concourse A, a new air freight facility, terminal roadway improvements and additional upgrades to improve the passenger experience. Total cost is estimated at $1.5 billion and work will be completed in phases through 2028.