Atlanta's Transformative Terminal Modernization: From Design to Reality

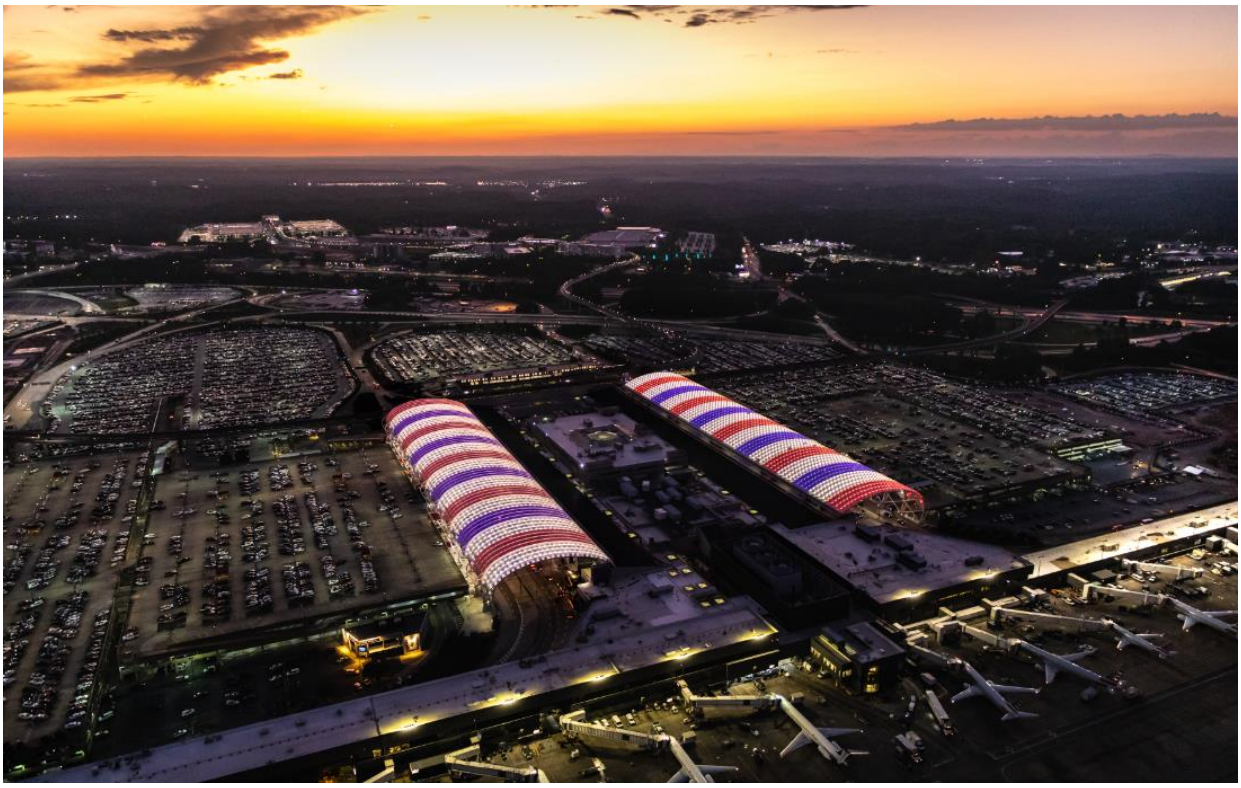

Figure 1: The domestic terminal canopies at Hartsfield-Jackson Atlanta International Airport (ATL) illuminated for Labor Day in September 2019. The canopies feature thousands of programmable lights. Image: ATL

Publisher's note: *This article first appeared in the Journal of Airport Management, Volume 14, Number 3 (Summer 2020) and is the property of Henry Stewart Publications. The article is reproduced here with permission.*

Editor's note: *This piece was written and edited in late 2019 prior to the spread of COVID-19. While the pandemic has impacted airport operations around the world, the coronavirus has had little influence on the design and construction ideas presented here.*

Authors: Matt Breidenthal and **Ripley Rasmus** of HOK**;** and **Jorge Cortes** and **Gary Summerlin** of the Atlanta Department of Aviation

THE MODERN(IZATION) ERA

Over the next two decades, the number of air passengers worldwide is expected to double, reaching 8.2 billion by 2037.[1] This growth in air travel has airports questioning how their facilities will accommodate unprecedented passenger volume while maintaining ongoing operations. This issue is of particular concern to airports in the U.S. where the average airport is more than 40 years old and designed for another era—one that existed before the heightened security of 9/11 and increased airline consolidation that has shifted more traffic to large and medium-size hub airports.[2] In addition to elevated traveler volume, many of the nation's older terminals were not designed with a focus on passenger experience that today's traveler expects and that airport operators rely on for improved operational efficiencies and revenue.

In recent years the culmination of these factors has helped fuel a modernization boom, with U.S. airports expected to spend $70 billion on new and upgraded facilities between 2018-2021.[3] And that

could just be a start. According to the Airports Council International, U.S. airports are in line for $128 billion in infrastructure upgrades between 2019 and 2023, with the nation's aging terminals earmarked for 56 percent of that investment.[4]

In 2015, Hartsfield-Jackson Atlanta International Airport (ATL) unveiled a master plan projecting an estimated $8.5 billion in upgrades that would allow the world's busiest airport to keep up with expected growth and demand through 2035.[5] Among other improvements, the master plan called for new parking garages, new taxiways and the possible additions of three new concourses and a sixth runway. Also on the list was the modernization of the airport's domestic terminal that would help the airport "provide a consistent passenger experience" across its terminals and concourses.

REVOLUTIONARY TO SECONDARY

Opened in 1980, ATL's Central Passenger Terminal Complex was unlike any other. Situated midfield between ATL's north and south airfields, the original complex consisted of a centralized terminal building (today known as the domestic terminal) that connected to a series of midfield concourses via an underground people mover known as the "Plane Train."

This configuration, now replicated at airports around the world, significantly improved connections for travelers while also boosting operating efficiencies for airlines. Today ATL is recognized as not only the busiest airport in the world (with 107 million enplaned passengers in 2018) but also the most efficient, a title the airport has maintained for 16 consecutive years[6] despite the challenges posed by near-constant expansion and construction.

In the mid-1990s the airport finished building a fifth concourse (the 1.3 million-sq.-ft. Concourse E) that opened as the nation's largest international facility. In the early 2000s ATL began constructing a fifth runway that would become the largest public works project in Georgia history. And in 2012 the airport introduced the Maynard H. Jackson International Terminal, a $1.4 billion state-of-the-art facility that created a grand second entrance to the airport with its fluid exterior of brushed steel and curved glass.

Over its four-decade lifespan, ATL's domestic terminal has received several significant interior renovations, including the creation of a retail-inspired three-story atrium space in the mid-1990s. The exterior of the building, however, has remained largely untouched since its construction in the late 1970s. In recent years the building's concrete exterior has provided a sharp contrast to the gleaming new exterior of the international terminal. Yet it is the domestic terminal that has the most ability to impact public perception of the airport as nearly as nearly 9 in 10 of ATL's O&D passengers arrive and depart via that facility.

Figure 2: The landside approach to ATL's domestic terminal prior to the recent modernization. Passengers entering and departing the terminal had to cross multiple lanes of traffic and were exposed to sun and rain. Image: ATL

Beyond aesthetics, the domestic terminal's entrance also presented a challenge to passenger comfort and safety. Visitors arriving landside approach the terminal along one of two roadways that take them to drop-off and pick-up lanes on either side of the building (south side for Delta; north side for all other carriers). These wide, open-air arrival and departure areas left passengers exposed to rain, sun and even the occasional snow and sleet. Additionally, people walking to and from the terminal's adjacent parking garages have to navigate through eight lanes of vehicular traffic, posing a risk to guest safety and complicating traffic flow.

Given these issues, the modernization of the domestic terminal emerged as a top priority when ATL stakeholders first convened to map out the airport's 20-year master plan. At the same time, a question emerged: How could ATL revamp this crucial facility without impacting ongoing operations and risking its title as the world's most efficient airport?

Figure 3: This drone photo shows the canopies as they appeared in August 2019. Image: ATL

BUILD NEW OR IMPROVE?

Multiple factors can shape an airport's approach to modernization. These include site constraints, operational challenges, financing and urgency.

For some airports, the scope of the work can be so great that it merits tearing down an existing terminal and building new, such as what is happening today at LaGuardia Airport in New York City where a replacement terminal is being built in the same footprint of an outmoded—yet still operating—terminal. Elsewhere, the availability of land coupled with magnitude of an expansion may justify building an entirely separate new terminal. Salt Lake City International Airport's new 78-gate terminal facility—slated to become the first entirely new airport built in the U.S. since the completion of Denver International Airport in 1995[7]—provides an example of that.

For ATL, a replacement of the domestic terminal did not make sense for several reasons. From an operational standpoint, the building is arguably the most crucial component of ATL's efficient design

making it impossible to take it out of commission to construct a new terminal. The airport is landlocked with little room for physical expansion and current transportation feeds into the terminal, including Atlanta's mass transit system and adjacent parking structures. Structurally, too, the building is sound. A far better alternative was to renovate the terminal in a way that would enhance the passenger experience and completely alter the character of the building.

The 2015 master plan outlined improvements to the building's atrium space, its signage program and security screening operations. But the focus of the modernization would be on exterior upgrades, including a complete overhaul of the terminal facade, new pedestrian bridges over the roadways and—most significantly—two massive canopies spanning eight lanes of traffic. Combining both form and function, the canopies would create an architectural icon for Atlanta and a new "front door" for the airport while also providing safety and shelter to pedestrians.

Figure 4: A new vision for the landside approach to the domestic terminal, with a canopy covered in transparent ETFE paneling, pedestrian walkways spanning the traffic lanes, and a new terminal facade. Rendering: HOK

MARRYING OLD WITH NEW

Each day an average of 95,000 passengers arrive or depart ATL's domestic terminal.[8] Several thousand more employees and vendors also enter and exit the building via its front doors. Outside this main entrance, tens of thousands of vehicles—shuttle vans, taxis, ride-sharing services and personal autos—pass by each day to drop off and pick up passengers, families and friends.

ATL challenged its design team to improve this entry and exit experience while also minimizing the impact construction would have on passengers, visitors and airport and airline operations. The team began by exploring ways the facility's existing architecture and infrastructure could support the goals of the modernization. The building's air-intake towers, for example, had the potential to be more than just a mechanical necessity for the terminal. If clad in a new skin, the towers created interesting and powerful accents to the terminal entrance. Replacing the building's pre-cast concrete facade with metal and glass panels provided the terminal with a more contemporary exterior while introducing additional daylighting into the check-in lobby.

Designing and engineering the canopies presented a more difficult challenge for the team. The airport's planners initially envisioned fabric-covered canopies supported by a metal framework that reached its greatest height near the parking garages—a design that risked drawing people's focus away from the terminal entries. Structurally the original concept also would be problematic as it required new support columns along the drop-off and pick-up curb. Airport facilities located below the curbside would have made the installation of these new columns extremely disruptive to ongoing operations.

Instead, the design team began examining how the canopy might connect to the terminal without the need for new columns at the terminal curb. A threefold solution emerged that incorporated 1) an in-depth investigation of the terminal's structural integrity, 2) parametric modeling software allowing for rapid design evolution and analysis, and 3) the use of modern, lightweight materials that would allow for a free-span structure that draws people's attention toward the terminal entries.

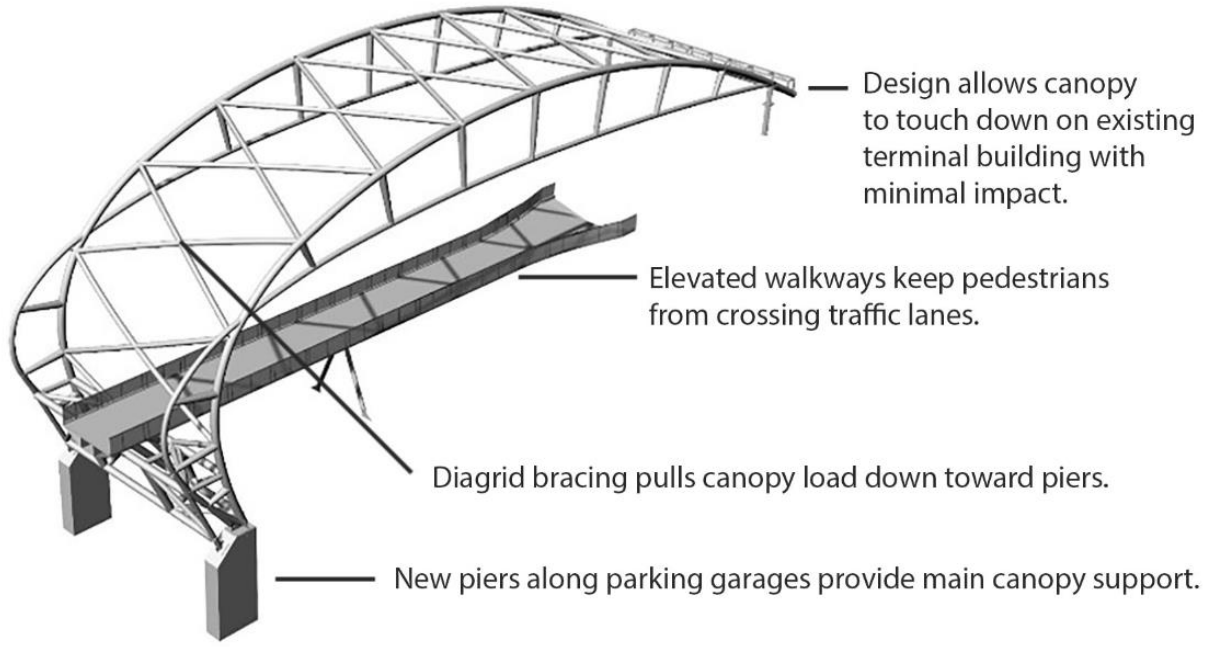

Figure 5: Technical illustration of canopy structural system. Image: HOK

MODERN TOOLS, MATERIALS AND APPROACH

While new columns located along the curbside were not ideal, an examination of the building's original blueprints suggested that existing columns within the terminal could provide supports for the canopy frame. What the blueprints couldn't provide, however, was the current condition of the columns after 40 years of airport modifications and general wear and tear. This is a common challenge design and construction teams encounter with airport modernizations as information about the current state of facility infrastructure is often incomplete, inaccurate or outdated.

An initial assessment of the columns found the majority were either located in difficult-to-reach sections of the terminal critical to airport operations or would require costly and time-consuming reinforcement and repairs. But could those columns work with a different canopy design?

That became the new focus of the design team. Using parametric modeling software to quickly test new concepts, the team developed an alternative canopy design that placed two-thirds of the structure's load onto new support piers located near the parking garages. The terminal columns, by contrast, would

have to support a much smaller percentage of the overall weight of the canopy. This design change allowed the existing terminal columns to support the canopy and reduced the amount of structural work to the terminal columns by 75 percent.

Key to the new canopy design was the use of ethylene tetrafluoroethylene (ETFE), a fluorine-based plastic, for the covering of the canopy. ETFE is 1/100th the weight of glass and more durable than canvas. Additionally, the material allows for expansion and contraction as the metal framework for the 864-foot-long canopies is expected to expand and contract as much as three inches depending on outdoor temperatures.

Bearing pads atop the terminal columns allow the 19 steel trusses that form the backbone of each canopy to expand and contract without placing lateral forces on the building. Diagonal braces between the trusses pull the weight and seismic and wind loads of the canopies downward where they connect to new concrete piers, some with micropiles that extend 75 feet below the surface.

CONSTRUCTION WITH LIMITED DISRUPTION

Figure 6: Construction of the south canopy and new terminal facade near completion in September 2019. Work on pedestrian bridges over the traffic lanes will continue into 2021. Image: ATL

Construction of the terminal's north canopy began in the fall of 2017 and finished in late 2018. Work on the south canopy began immediately afterward and is expected to be completed by the end of 2019.

Prior to the start of the project, ATL management and its stakeholders emphasized that construction of the canopies could not impact the airport's operational efficiency. Charged with that mandate, the design and construction team implemented a plan to expedite construction with as a minimal an impact as possible. Those strategies included:

Flexibility: The design allowed trusses to be erected simultaneously, from one end to the other, or from the middle out. Ultimately it was decided to begin construction on the north entrance to the terminal as it has less passenger traffic.

Multi-staged truss assembly: The size and scale of the canopy trusses required the team to develop a system to expedite their on-site assembly. Manufactured 1,000 miles away in Lubbock, Texas, the trusses arrived via wide-load tractor trailers in five separate pieces. Once on site, construction crews reassembled the trusses into three sections—a column piece connected to the pier, a mid-span piece and a long-span connector that fastened to the terminal. Each section took one evening to erect with a full truss (measuring 174 feet wide and 73 feet tall) requiring three evenings to complete. Bolted connections allowed crews to quickly fasten the pieces together without the need for welding.

Anticipating FAA and site challenges: Airspace restrictions meant the airport couldn't use a stationary tower crane—the type of mechanical lift most often associated with large-scale construction projects. Instead, the team used telescopic crawler cranes that complied with FAA height regulations but also presented another challenge as the heavy, mobile machinery was often working above subterranean airport facilities. To safeguard damage to these areas, the design and construction team developed a rigging and erection plan the made efficient use of pick lengths while minimizing point loads.

Phased construction: To minimize impact to passengers and airport operations, much of the canopy assembly occurred overnight between the hours of 10 p.m. and 4 a.m.

Traffic management: ATL and the construction team evaluated more than 400 traffic management plans prior to the start of project. Once work began, the team constantly assessed and fine-tuned its traffic plan to minimize impact. At times the construction closed three lanes of traffic, but it never shutdown all eight lanes during operating hours.

Communications + signage: Anticipating the need to inform airport stakeholders and the public about work updates and delays, the airport established a dedicated project communications group prior to construction. Working closely with the construction team, the communications group provided weekly project updates and look-aheads for dissemination to airlines, vendors and the media. This group also handled on-site signage, which included overhead banners and wall wraps.

Figure 7: Before, during and after renderings show the evolution of the project from pre-construction through final build. Images: HOK

RESULTS AND LESSONS LEARNED

Initial reaction to the canopies has been resoundingly positive, especially from those who view the structures at night. Incorporated into both canopies are more than 3,400 light fixtures, each with an array of programmable LED lights that can change color to create hundreds of different patterns, designs and messages. Images of the canopies and their light displays have become wildly popular on social media and garnered national and international media exposure for the airport.

Passengers who arrive by day have other reasons to appreciate the canopies as the shaded ETFE panels reduce the intensity of the sun by 50 percent and have measurably reduced the temperature at curbside. Other benefits have yet to be quantified, but ATL leaders believe the protection the canopies offer from sun and precipitation will put passengers at ease at the outset of their airport journey and translate to better experiences at more high-stress areas, such as check-in and security screening. Installation of the first of four pedestrian bridges beneath the canopies has just begun. Completion of all four bridges by 2021 should dramatically improve passenger safety and mobility when entering and exiting the terminal.

Like any project of this scale, there are some things the airport and its designers and contractors would do differently a second time around. Lessons learned include:

Understand your current facility: It's impossible to overstate the importance of having reliable building and grounds information prior to starting a modernization project. Existing building plans are not enough as not all changes made to a facility over the years and decades will be accurately documented. Early investment in building discovery, soil reports and other facility analysis will always lead to a better outcome.

Allow for contingencies: Even the best planning and early analysis won't keep surprises from popping up during large-scale modernization projects. Teams must factor unforeseen construction complications into the project schedule and budget and look ahead to outside circumstances that may impact the project, such as commodity and labor costs. Increased project scope compounded by other factors (including a doubling in steel costs prior to bidding, a hyper-competitive labor market with two Atlanta sports stadiums being built at the same time as the canopies, and unexpected expenses for extra policing and staffing) led to cost increases for the terminal's exterior renovations and expanded its budget from around $165 million to $265 million. Those increased costs have led the airport to revisit some other updates to the terminal that also were part of the master plan.

Communicate, communicate, communicate: It may sound obvious, but communication is crucial to the success of any large-scale design and construction project. The airport engaged a construction manager to serve as an advisor during the design process. Having designers and build teams engage in conversation early and often can eliminate many problems once development begins. Communication with airport stakeholders and the general public is also key and must be more than just a one-way channel. Suggestions and feedback from airport users helped the airport improve both traffic management and operations during construction.

CONCLUSION

No two projects are the same, and no two airports have the same exact needs. The canopies and related exterior renovations at Hartsfield-Jackson Atlanta International Airport provide one example of how an airport can dramatically alter its look and perception through modernization. Airport managers looking to take on transformative terminal and concourse modernization should begin the process with a thorough investigation of current facility conditions.

A strong design and construction team can help airport officials imagine the possibilities and ensure that the design vision can become a reality. Unlike greenfield projects, special attention must be made to determine how new architecture can work with—and complement—existing airport infrastructure. Equal attention must be given to construction planning to ensure construction work has minimal impact on vehicular access to the airport, passenger movement within the terminal, and overall airport operations and efficiency.

Airport officials should anticipate the unexpected when updating aging facilities as hidden issues can be expected to arise during building prep and construction. Contingency plans and strong, inter-team communication can help mitigate the impact of these surprises and lead to successful projects.

As the number of air passengers continues to rise and as travelers continue to expect a better passenger experience, it's no longer a question of if an airport will need to modernize. It's when will they do so, and how will that modernization keep them relevant for the decades to come? Transformative modernizations such as ATL's terminal canopies prove that dramatic change is possible and provide a pathway for other airports to follow suit.

---

[1] International Air Transport Association (2018) "IATA Forecast Predicts 8.2 billion Air Travelers in 2037"available at: https://www.iata.org/pressroom/pr/Pages/2018-10-24-02.aspx

[2] Architectural Record (2018) "U.S. Sees Rise in Airport Construction" available at: https://www.architecturalrecord.com/articles/13366-us-sees-rise-in-airport-construction

[3] Ibid

[4] Airports Council International (2019) "Terminally Challenged: Addressing the Infrastructure Funding Shortfall of America's Airports" available at https://airportscouncil.org/intelligence/airport-infrastructure-needs-study/

[5] Atlanta Dept. of Aviation (2015) "Master Plan Executive Summary"

[6] Air Transport Research Society's 2019 Global Airport Performance Rankings available at: http://www.atrsworld.org/docs/2019Mediarelease.pdf

[7] Desert News (June 18, 2019) "Why building new airports like Salt Lake City's is rare, and what it might mean for your travel plans" available at: https://www.deseret.com/2019/6/19/20675980/why-building-new-airports-like-salt-lake-city-s-is-rare-and-what-it-might-mean-for-your-travel-plans

[8] Hartsfield-Jackson Atlanta International Airport