SIGHTLINES: A New Airport for St. Louis

Keywords:
Airport Architecture
St. Louis
Sightline
Intersection
Program

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Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of Master of Architecture in Architecture.

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Defense Date:
November 1, 2010
Blacksburg, VA

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ABSTRACT

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A consideration of the challenges that make airports such a difficult building type to design, use and visit; and a new airport that proposes to use unconventional layout, expansive windows and open sightlines to provide a more welcoming building to users, employees and visitors.
ACKNOWLEDGEMENTS

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INTRODUCTION

An Opportunity Lost

In many respects, the airport should be the perfect architectural opportunity. They often pair top-notch firms with cutting-edge structural engineers and ten-digit budgets. They are granted a litany of code exceptions and given the chance to serve as ambassadors for the world’s great cities. As a program, the airport is tinged with the excitement of new places and reunions with friends and family - all set against the backdrop of the human fascination with flight.

Yet in spite of this, most people approach the airport with apprehension at best or dread at worst, regardless of whether they are on their way out of town or going to meet a weary traveler.

Some of the reasons are architectural. For example, airport design relies on repetition to account for scale. This can occur from the level of a dozen identical sinks in a bathroom to a hundred identical gates spread over a concourse. It can make an airport feel disorienting and endless. And because scale magnifies expense, the pace of modernization and renovation can be slow, making some airports feel dingy and outdated.

But far more of the reasons are out of the control of the architect. Land values force airports out to the fringes of metropolitan areas. Travelers feel hassled by airline and security restrictions. A person may have to walk a mile from the airport entrance to the plane, and that journey can take more than an hour if conditions are unfavorable. The challenge for the airport designer therefore is to try to highlight the positives of air travel and captivate every visitor’s sense of wonder.
LESSONS

Brave New World

All airports, successful or unsuccessful, have lessons to teach future designers, and most airports have successful and unsuccessful characteristics.

But one thing they nearly all American airports have in common is that they were built during a different era of air travel. The growing prominence in the 1980s of the “hub and spoke” system in response to the Airline Deregulation Act of 1978 all but did away with direct flights between most small markets, giving rise to massive hub airports in Atlanta, Denver, Chicago and Detroit, among others. Passenger volume more than tripled between 1975 and 2000, while the number of major air carriers decreased due to declining profits and consolidation pressures.

Terrorist events in 2001 brought about a spate of reactionary changes: many of them regulatory, and all very hastily. No longer was it possible for airport visitors to clear security to meet arriving passengers at their gate, nor even to park close to terminal. Ticketed passengers were subjected to new screening guidelines regarding jackets, laptops and shoes, and prohibitions against sharp objects, matches and even liquids were applied to carry-on luggage.

As security protocols continued to evolve in subsequent years, cash-strapped airlines changed protocols of their own in response to declining profits from a skittish flying public. New fees charged to travelers wishing to check a bag prompted more and more people to carry on their luggage, exacerbating already tense and slow security lines. The ubiquitous ticketing kiosk replaced more and more ticketing agents to the perceived detriment of customer service.
For all of these changes, only three of the nation’s thirty largest airports were built after 1970: Baltimore/Washington Thurgood Marshall (1973), Atlanta Hartsfield-Jackson (1980) and Denver International (1995). Though the rest have all undergone renovations and expansions through the years, a significant, international airport designed from the ground up for today’s climate has yet to be constructed in this country.

The airport designer therefore needs to identify up front the programmatic constraints, new and old, that they are likely to encounter. For example, one fundamental characteristic of airports is that they have always been divided into public and secured space. Therefore the passage from public to secured space is inherently a limiting factor in efficient passenger flow and must be carefully considered in the design.

The trend in American airports right now is to centralize airport security to one primary location for all travelers. Denver International Airport is the country’s most recent major airport and has this feature. Dulles International Airport centralized its security to an underground 113,000sf screening facility as part of its significant 2010 renovations.

There are operational advantages to this approach: supervisory functions can be centralized, specialized protocols for searches can be consolidated and passenger flow is very easy to monitor. It also avoids the inefficiencies created by uneven loads across multiple checkpoints.

For the passenger however, the sheer volume of such an operation can be intimidating. A wait in line behind hundreds of fellow travelers can seem endless, even if the line quickly dissipates into dozens of individual lanes and takes less than 20 minutes total. By contrast, Charlotte-Douglas International or LaGuardia, for example, have multiple screening areas where the number of passengers in line may be in the dozens rather than hundreds.

Such a system may not necessarily save the passenger any time over a centralized screening area, but they may perceive the screening as less of an ordeal if they have a direct view to the end of the process and can count the number of people in line in front of them. Thus an architect can use sightlines to manipulate passenger perception, which can make all the difference to the user experience.

[DEN]: Central security at Denver International Airport
Among the most important sightlines to travelers are those to the outdoors. A traveler flying from one coast to the other in this country might well be stuck inside airports and planes for eight hours or more if they are forced to make a connection. But with few exceptions, airports fail to connect visitors to the outdoors very successfully. Kona International Airport takes advantage of Hawaii’s year-round hospitable temperatures by having spaces that are half inside, half outside. But most airports rely on windows, and not many use them effectively; many windows in airports look out onto other concourses, parking structures, etc.

Charlotte Douglas Airport has unusually successful windows. Their size and orientation bring high-quality light deep into the main central terminal (below). The view across the tarmac captures planes taking off and landing in the foreground set against the city skyline, connecting travelers to both the building’s program and the city.
The size of many airports can alienate and intimidate visitors. The larger the airport, the easier it is to get lost and the longer it can take to reach a destination. But a massive scale is of course a programmatic inevitability, so a thoughtful designer should find a way to turn the scale to their advantage. Scale has the ability to not only intimidate, but to impress. The problem with so many airports is that they manage to be large without being grand.

Atlanta Hartsfield / Jackson International Airport is a case in point. It is an exceptional airport functionally - easy to navigate and an efficient hub to make a connection. This is in spite of handling 50% more passengers than Chicago O’Hare, the country’s second busiest airport.

But few would describe any of the spaces as grand. The ceilings in most places are seldom more than sixteen feet and are largely comprised of hung acoustic tile. The visual connections between different sections of the airport are universally poor; a traveler arriving in a given concourse can’t see the end of it with the naked eye.

By contrast, Eero Saarinen, in his designs for the TWA Terminal at John F. Kennedy International and Washington Dulles International, took advantage of something that European train stations have always employed. He created spaces with a generosity of both scale and gesture: open, sweeping areas with beautiful lines. This kind of architectural judo turns a potential liability into an asset: grand spaces with appealing, accessible sightlines.

Opposite: [JFK]: Detail from Eero Saarinen’s iconic TWA Terminal (Terminal 5), JFK International Airport.
This page: St. Pancras International, train station, London.
I selected the St. Louis metropolitan area as the site for my project. The existing airport, Lambert - St. Louis International, is aging and receives poor reviews from many travelers despite its place in history as a pioneering design. It was once the primary hub for TWA, but when American Airlines bought out TWA’s assets in 2001, it became only a minor hub and the number of passengers fell from 30 million in 1999 to 15 million in 2007. But demand is increasing again, and St. Louis’ central location makes it a key hub for cargo.

The centrality of St. Louis makes it an excellent potential hub for cross-continent travel as well. Dallas/Ft. Worth International Airport [DFW] and Chicago O’Hare [ORD] serve as major hubs for large carriers and are key connection points for cross-country itineraries. But each airport provides an indirect pathway; O’Hare taking passengers far north while Dallas/Ft. Worth is “deep in the heart of Texas.” Fuel costs could drive airlines to seek more direct routes across the country as well as increasing demand for regional routes. (A connecting flight from Washington to Los Angeles, for example, would save more than a hundred miles connecting through St. Louis over either of those two, or two hundred compared to Atlanta or Denver).

A meaningful way to illustrate this is using a technique called “Load-Center Diagramming,” which can be used to identify the effective center of the American air travel grid. It is calculated using the passenger volume and geographic location of the nation’s 32 largest airports. Given its approximately central location and the higher density of the east coast, it is not that surprising to discover that St. Louis is within 70 miles of this center.
A load-center diagram of the United States’ 32 most significant airports
Transportation

In selecting a site for my airport, it was essential to me that it could be easily connected to the existing transportation grid, including highways, rail and water. The flexibility created by giving people and cargo access to a variety of modes of transit allows travelers and shippers cost-effective and ecologically responsible options. Fluctuating fuel costs continue to spur conversation of “intermodal transportation.” A 2008 agreement between then Governor Matt Blunt of Missouri and the People’s Republic of China designated St. Louis as the primary transportation gateway for cargo traveling between China and the United States, creating the perfect opportunity to develop such an intermodal hub.

A new airport in St. Louis could better take advantage of the unique transportation resources the region offers. Lambert is located west of the city, but building to the north and east would allow direct access to navigable parts of the Mississippi River. St. Charles County, adjacent to St. Louis to the north, is located between the banks of the Mississippi and Missouri rivers and could reasonably provide access to both. An airport adjacent to the water could also transfer cargo to highly-efficient barge carriage to downriver Memphis, the hub for freight carrier FedEx.

Finally, the site is adjacent to two Class I cargo railroads, CSX and Norfolk Southern, and greater St. Louis offers access to four more. There are also four Interstate highways that intersect in St. Louis: I-44, I-55, I-64 and I-70, which radiate directly outward to Kansas City, Chicago, Louisville and Indianapolis within 300 miles, continuing on to Dallas, Denver and the coasts. Two of these traverse St. Charles County, passing within miles of my site.
Aviation in St. Louis

The city also has a rich aviation history. Charles Lindberg’s famous solo flight between New York and Paris first originated in St. Louis before stopping in New York, giving rise to the name to his plane “The Spirit of St. Louis.” Theodore Roosevelt was the first U.S. President to fly in an airplane, departing from what would later become Lambert Airfield. St. Louis was also the home of the erstwhile McDonnell Douglas company, and has been called the “City of Flight.”

My exact site in St. Charles County is the current home of Smartt Field, an airstrip which houses the museum and several aircraft of the Missouri Wing of the Commemorative Air Force, an organization devoted to the history of military aviation in Missouri, particularly from World War II. Smartt Field’s hangars are filled with classic aircraft, constantly being tinkered with by CAF veterans.
CONCEPT

Gateway

Early design decisions were influenced primarily by my site. Because I selected St. Louis based on its centrality, a theme reinforced by its moniker “Gateway to the West,” I wanted the building to have an omnidirectional character. The themes of travel and cardinality are emphasized further by the compass-like shape of the building. The four directions symbolized by the three concourses and the approach roadways are an obvious allusion to North, East, South and West, but are also a nod to the intermodal goals of the project manifested as transportation by air, road, rail and water.

One site-specific element of the building is that all of its functions are located above ground. A 1993 flood of the Mississippi River, cresting at 49.6 feet above normal in St. Louis (or 20 feet more than flood stage), left Smartt Field four feet under water. It was an anomalous occurrence, classified by the National Oceanographic and Atmospheric Administration (NOAA) as a 500-year flood event. Nonetheless, buildings in the area have been designed with an eye to caution. A nearby coal plant is built entirely above ground, with artificial earthen embankments built like a wall around its perimeter.

All areas of my airport are all built above ground, with the vast majority of functions, including the concourses, built no less than twenty feet above ground. A byproduct of having the concourses raised is that passengers walking in the concourses are above and can pass over the ground paths of taxiing aircraft. In conventional airports, passenger and aircraft flow are forced to work around each other, causing both to travel much greater distances.
Early in the process I began to experiment with a “double concourse” system (below). In a conventional system, an arriving aircraft pulls into a gate, unloads its passengers, is serviced, loaded with new passengers and sent on its way. Taking advantage of the elevated concourses, my system has the aircraft pull under an ‘arrivals’ concourse to deplane, then pull forward to ‘departures’ to be loaded with new passengers. Transferring passengers are routed as they leave the plane through elevated passages to the ‘departures’ concourse without having to clear security again, (represented by green arrows in the diagram on the right).

Maintaining a separate concourse for arriving flights has two distinct advantages. First, because each gate is “paired,” planes can spend less time in each one, improving ground time and cutting the number of gates needed. This also effectively shortens the distance from the terminal building to the end of each concourse. But more importantly, the arrivals concourse could be public space, allowing airport visitors to once again meet arriving passengers at their gate, without even having to pass through security.
Security

Considering the advantages to both centralized and decentralized security discussed on page 4, I aimed to get the best of both worlds by centralizing all security functions to the third level of the airport in its own “structure-within-a-structure.” Checkpoints, lines and Transportation Security Administration (TSA) offices are all located within an semi-opaque glass ring suspended over the ticketing level, supported on the airport’s 16 primary columns and by additional columns adjacent to elevator shafts, restrooms and airline offices. Housing all security functions within a single area allows organization to remain centralized and order easy to preserve from the standpoint of the TSA.

But for the passenger, there are six systems of escalators carrying them into the security ring, two for each of the airport’s three concourses. This minimizes the visual impact of having one line to serve the entire airport, and provides a direct sightline to the end of the screening process from the time the passenger arrives into the security level. The relative proximity of the different lines allows security officials to even loads when needed by diverting passengers from one section to another.

The walls of the security ring are made of translucent glass, the only break from the otherwise open and uninterrupted sightlines between the levels. One reason for this is to identify the level as having a significant function, distinct from the rest of the airport. It is also designed to suggest a degree of anonymity and privacy, as figures are silhouetted rather than directly visible through the glass. Airport security is perceived by most as invasive to personal privacy, so the glass is perhaps a nod to restoring some to the traveler. (In most airports, security is conducted in the open, where passersby may see a fellow traveler having their bags emptied onto a table, or being told to spread their legs and be searched by security personnel). But the translucency is enough to make the sightline appear animated, and for passengers below, to be able at a glimpse to judge the relative crowds in different regions of security and choose an entrance for themselves.
Space and Repetition

My airport aims in its basic design concept to restore the grandeur of Europe’s great train stations, New York’s Grand Central Station and Saarinen’s iconic airports. It may feel large upon entry into the main terminal building, as the undulation of the roof sweeps to a height of a hundred feet at its crests, visible immediately from any entrance. Yet one can walk a full circle through the terminal building in a fraction of the time it would take to cross from one end to the other of Atlanta or Charlotte’s main ticketing area.

The airport’s functions, from ticketing to restrooms to security to baggage, are stacked vertically and organized radially, drawn from the inherent efficiency of a sphere. So while the initial sightlines may be imposing on entry, the actual distance a person must walk within the airport can be surprisingly compact. As I suggested in my introduction, there is an inevitable scale a designer must address with an international airport; my airport attempts to be as judicious as possible with the distance between any two functions while using the magnitude of the building to be visually striking.

Likewise the design of the building seeks to turn repetition from a design pitfall into an organizing principle. If my airport can be loosely construed to have four repeating sections in the main terminal, consider their relative efficiency and simplicity to navigate compared to a traditionally laid out terminal building housing the same functions in the drawing on the right:

Repetition is used in a slightly different way in the concourses radiating outward from the terminal building. Concourses are invariably long in any significant airport, and though my design uses doubled concourses as described on page 16, and are a fraction of the length of concourses in a traditionally designed international airport, they still reach nearly 1,130 feet from terminal to terminus.

I used repetition to combat the intimidating length of the concourses by breaking them down into five larger “nodes” where a passenger presents their boarding card and descends into the plane, connected by five narrower passageways. The trip out to the end of the concourse alternates between these compressed and expansive spaces that are countable on one hand. Thus, though the distance is great out of necessity, the perceived distance is substantially shorter than a typical concourse of almost abstract length where a traveler counts thirty or more gates along a passage of uniform width and height throughout.
Throughout my airport, I attempt to take advantage of sightlines to alter not distances, but the perception of distances between the places a traveler visits. But the design uses sightlines for more than mitigating scale and repetition. When a passenger first walks in the door to the terminal building, airplanes are visible immediately through the expansive glass that makes up the perimeter of the building. There are no full-height opaque walls (other than the restrooms), no underground trains, and no windows looking out onto other buildings. A visitor instead walks in and can understand the flow of the building. Looking down through the openings in the main floor, they see baggage carousels and car rental agencies. Looking up they see the glowing translucent ring that houses security, and on top of that the passages out to the aircraft. Views from the ends of the concourses, sixty feet above ground level, include patchwork farmland to the east and west, the Mississippi River and granite bluffs of Illinois’ shores just across to the north, and train tracks, small towns, the Missouri River and, way off in the distance, the skyline of St. Louis to the south.

The outer windows of a round building must inherently look outward. The curtain walls that define the building’s perimeter offer unimpeded views of soaring concourses, airplanes beneath and runways just beyond. The backdrop of departing and arriving planes is a constant reminder of what lies ahead, an important visual cue that beyond the fees, the security screenings, the lines and the hassle, the promise of new places, new opportunities and old friends may only be a short flight away.
DEPARTURE
Site plan, St. Charles County, Missouri
Floor plan, arrivals level
Floor plan, security level
Section (top) and simplified floor plan, concourses
Section, main terminal building
APPENDIX B:
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Additional thanks to Autodesk, Rick Bell, Cardinal Blueprinting, Mario Cortes, Robert Eisenstat, Google, Henry Hollander, Susan Piedmont-Palladino, Hans Rott, Josh Saks, Eero Saarinen, Ian Schwab, Claudia Shuba, Steve Thompson and John van Amburg