

Mass Transit at Phoenix Airport

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PHX Sky Train headed east over the Taxiway R Crossing, Terminal 4 and the control tower in the background. Courtesy of Bob Perzel.

On April 8, 2013, Phoenix Sky Harbor International Airport opened the first stage of the PHX Sky Train™, a 5-mile long automated transit system exclusively serving the Airport. Expected to carry 2.5 million passengers a year, the system provides a dedicated, streamlined, safe, convenient, and more sustainable transportation link between airport terminals, parking lots, rental car center and regional light-rail transit facilities, and reduces congestion around the airport terminals. This is no small feat given that Sky Harbor is one of the ten busiest airports in the country.

Known as one of the largest economic engines in the state of Arizona, Sky Harbor currently serves over 40 million people a year and has grown steadily throughout its 75 year history. Since the development of its newest terminal in the late 1980s, the Airport has contemplated building a transit system to deal with traffic congestion due to increasing passenger demand and aging ground transportation infrastructure. Without the Sky Train, projections show that quality of service and future Airport growth would be crippled by gridlock on the Airport's roadways.

Planning efforts resulted in a 5-mile long corridor for the Sky Train in three stages to spread overall funding requirements. Currently operating, Stage 1 consists of approximately 2 miles of guideway, of

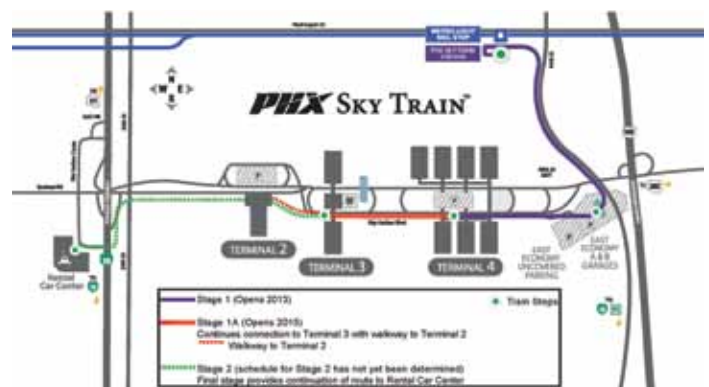


Figure 1: PHX Sky Train route map. Courtesy of Phoenix Aviation Department.

which over 1.5 miles is elevated, to connect three stations: a Metro light-rail stop; a major airport parking facility; and Terminal 4, the largest airport terminal. Stage 1A, which is now under construction, builds a new station at Terminal 3, approximately ¾ mile of guideway and a walkway to connect the Stage 1 facilities and Terminal 2. The final stage is in conceptual design and will provide future connections to the rental car center and another major airport parking lot (Figure 1).

Transit System Planning

Constructing a dedicated transit system within an operating airport is costly and will unavoidably impact existing facilities and operations. However, the Phoenix Aviation Department determined that long-term benefits outweighed the short-term cost and potential disruptions. Projections for Sky Harbor showed that an automated transit system would be the best way to increase landside capacity and avoid restricting future airport growth. To maximize benefits, planning considered long-term development of the Airport, opportunities for transit oriented development, strategies to maximize ridership on the system, and repurposing an adjacent underutilized freeway.

- Station siting – providing connections at the airport terminals, parking facilities, rental car center and the regional light rail system, stations are located to serve passengers as well as airport and airline employees and other support staff. When fully operational, the Sky Train will eliminate existing



Figure 2: Map showing the location of the Maintenance and Storage Facility (MSF) and SR-153. Courtesy of Gannett Fleming, Inc.



44th Street Station. Courtesy of Bob Perzel.

airport bus operations. Stations are sited and programmed to accommodate future parking garages, support facilities and potential private development to increase ridership.

- Accommodation for future stations – segments along the alignment are designed to accommodate future stations for additional airport parking and terminal facilities needed for long-term growth.
- Provide drop-off/pick-up away from terminal core areas – to relieve congested terminal curbs, designated non-terminal stations will accommodate buses, vans, shuttles, passenger vehicles, etc. This will create convenient passenger drop-off and pick-up areas that are a short Sky Train ride away from terminals.
- Repurpose an existing freeway – without a good connection to the surrounding regional freeway system, a section of freeway located just east of the Airport, SR 153, had historically been underutilized. The project uses a portion of the corridor to carry the Train at-grade, creating a very cost effective solution to what would otherwise have been a costly below grade alignment through a runway protection zone. The remainder of SR 153 was modified to a typical city street where it still has ample capacity to carry traffic flows (Figure 2). This freeway corridor reconfiguration is estimated to have saved the project approximately \$30,000,000.

Planning to Build in an Operating Airport

Sky Train infrastructure design required careful consideration of construction impacts on airport operations and facilities, as construction requirements drove many key design decisions. An integrated design and construction approach was used to help ensure that the project was built on-time and on-budget. At the 30% design level, a Construction Manager at Risk (CMAR) contractor was brought onto the team. The use of CMAR allowed early confirmation of construction schedule and budget, value engineering to be integrated into design, constructability issues and operational impacts to be mitigated during the design phase, and design tailored to the contractor's preferred construction approach.

A fast-track delivery of construction documents was necessary to minimize overall project schedule and risk associated with inflation and fluctuating material costs. In order to accomplish this, design and

construction schedules overlapped by 2 years in an overall construction schedule of 3.5 years; and, to allow design to stay just ahead of construction, 31 separate design packages were issued. Building Information Modeling (BIM) was used by all design disciplines for vertical structures, and shared with the contractor to avoid conflicts and quickly resolve those that did occur.

The single most fundamental element to mitigating construction impacts to all airport patrons, tenants, airlines, and operations was developing and communicating a well planned construction plan, gaining buy-in by stakeholders, and executing it as scheduled. It was essential that the airport continue to provide for the needs of airport users even through the most demanding construction operations. Therefore, a thorough outreach to multiple stakeholders was critically important. Key stakeholders extensively involved in the project were: Airport Operations, Airport Facilities & Services, the Airlines, Federal Aviation Administration, Valley METRO Rail and the Union Pacific Railroad.

Some of the challenges mitigated by advanced planning and stakeholder communication included:

- Restricting heavy construction activities around Terminal 4 to nights in order to minimize effects of noise, dust and congestion from construction traffic on passengers.



PHX Sky Train adjacent to Sky Harbor Blvd. East of the Terminal 4 Station. Courtesy of Bob Perzel.



A US Airways jet passes beneath the Taxiway R Crossing with the PHX Sky Train overhead. Courtesy of City of Phoenix Aviation Department.

- Keeping the pedestrian bridge between concourses open while constructing the Terminal 4 Station and guideway directly above them.
- Minimizing the number of concourse gates that were closed during any given period. The Sky Train team worked closely with the affected airlines to minimize gate closures and scheduled work so that closures could be staggered, especially during peak travel seasons.
- One of the security checkpoints directly below the Terminal 4 Station was scheduled for expansion shortly before Sky Train construction. By working closely with the Airport and Checkpoint design team, the support columns of the Station in the area were constructed during the checkpoint widening work, thereby eliminating a future disruption.
- Sky Train's pedestrian bridge link to the Valley Metro Light Rail system crosses above the Light Rail's overhead catenary power lines. To avoid future disruption of Light Rail service, completion of the pedestrian bridge had to be advanced ahead of the December 2008 start of Metro Light Rail operations, several months ahead of breaking ground on Sky Train construction.

Creating a LEED Certified System

In January, 2013, the PHX Sky Train facilities achieved Gold certification from the U.S. Green Building Council (USGBC) under the Leadership in Energy and Environmental Design (LEED) for New Construction Version 2.2. Supporting LEED's priority to reduce greenhouse gas emissions, operation of the Sky Train alone will relieve terminal roadway and curb congestion and will result in approximately 20,000 fewer vehicles per day at Sky Harbor, thereby reducing CO₂ emissions by nearly 6,000 tons annually and ensuring that the airport's

Figure 3: LEED scorecard for PHX Sky Train Stage 1. Source: U.S. Green Building Council.

LEED Facts	
for New Construction (v2.2)	
Certification awarded Jan 2013	
Gold	44
Sustainable sites	5/14
Water efficiency	3/5
Energy & atmosphere	10/17
Material & resources	7/13
Indoor environmental quality	14/15
Innovation	5/5



Interior of the bridge over Sky Harbor Blvd leading to the Terminal 4 Station. Courtesy of Bob Perzel.

roadways flow freely. Efficiencies that were built into the Sky Train project, as documented by the LEED process, are expected to save the City over \$10 million dollars in the first 20 years of operation.

Initially, only the Sky Train stations were planned to be LEED certified. However, during the design process, a campus approach, whereby stations and guideway would be rated together, was chosen as the best option. This change was motivated primarily because the East Economy Lot station was changed from an enclosed to an open-air structure. While the latter consumes less energy, the baseline against which energy reduction would be measured was reset to an open-air structure. Although the first transportation project to be evaluated using a campus approach, it allowed credits to be computed as an aggregate for the guideway and stations, rather than by each individual station. The campus approach proved to be advantageous, allowing a score of 44 out of 69 possible credits, as seen in the details of Figure 3.

Stage 1 Grand Opening

With about 300 elected officials, business leaders and other invited guests in attendance, on April 8th of this year, the PHX Sky Train made its debut run from the 44th Street Station to Terminal 4. The automated, electric train's smooth and seemingly effortless ride stands in sharp contrast to the monumental effort that went into building it. Constructing nearly two miles of guideway at one of the busiest airports in the country without disrupting flights, halting traffic, or going over budget, is a huge achievement for the City, the contractors and the design professionals involved.

Challenges such as making the world's first crossing of an active taxiway, fitting the Terminal 4 Station around an existing pedestrian bridge and concourses, and weaving a narrow path between two multi-story parking garages, were overcome with collaboration, cooperation and perseverance. The end result is that the Sky Train has transformed the Airport's landside transportation system. Growing from a two terminal airfield serving 3 million people annually just four decades ago to a three terminal international airport serving 40 million passengers last year, completion of the Sky Train will position Sky Harbor to continue providing high-quality service well into the future. ■



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