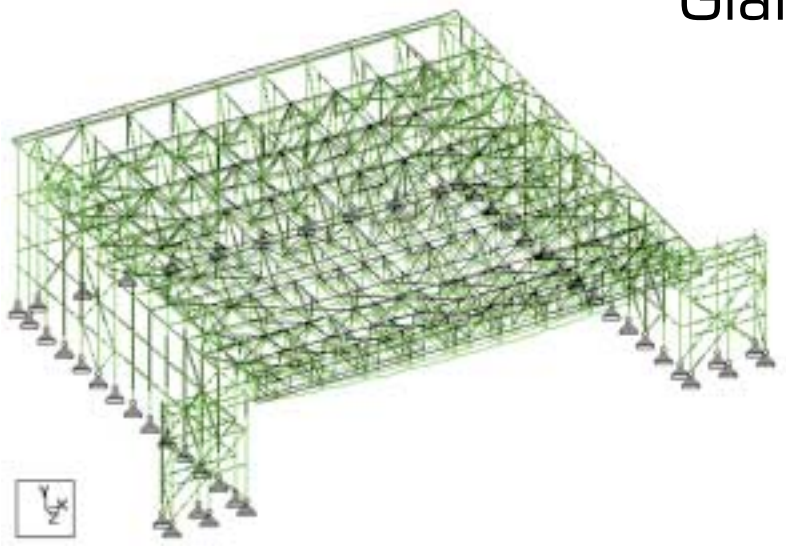
Three underhung cranes—two 5-ton and one 10-ton cranes which created a significant number of load combinations—posed a difficult challenge for the design engineers.

PARKING a PLANE

Giant Hangar for Giant Plane



Designers took particular care designing the structure's slender trusses, paying close attention to the deflected shape under various loading conditions, to meet the operational tolerances of the hangar doors.

Richard Portier, P.E., and Dan Talbott, P.E., S.E

The Airbus A330-300 aircraft, the newest addition to the US Airways fleet, is an enormous plane with a wingspan of more than 197′ and an overall length of 209′. In comparison, it is 41′ wider and 53′ longer than the Boeing 767-200ER aircraft that the airline has been using to fly its transatlantic routes.

Before US Airways could take delivery of its new fleet of planes, it needed an aircraft maintenance hangar large enough to accommodate the new plane at Philadelphia International Airport, support location for the air carrier's transatlantic service. Butler Heavy Structures (BHS), an operating unit of Butler Manufacturing Company of Kansas City, MO, worked closely with project architect Rosser International, Inc. of Atlanta, GA, and Anvil Construction Company Inc., a Philadelphia-based contractor, to develop and design a structural steel solution and cladding system that met the strict architectural and scheduling requirements.

Designed specifically to service the Airbus A330-300 aircraft, the unique 88,400-sq. ft. maintenance hangar is nearly 303′ wide and 281′ long. At the front of the building, the roof is nearly 87′ above the finished floor and it rises

(top) The US Airways Hangar, designed and built specifically for the Airbus A330-300 aircraft, is a unique 88,400-sq. ft. maintenance facility, which is nearly 303′ wide and 28′ long. At the front of the structure, the roof is nearly 87′ above the finished floor and rises to a height exceeding 106′ at the back of the building. Over 1,200 tons of steel were used in the structure. (right) The design team chose to use a flat-bottom roof truss scheme that varied the truss depth to create the proper roof pitch.

to height exceeding 106′ at the back of the building. Two 5-ton and one 10-ton underhung cranes span the 303-foot width of the building, supported by eight trusses specifically designed for the task. Over 1,200 tons of steel were used in the structure. Total cost of the project was approximately $35 million.

One essential key to meeting the completion deadline was BHS's decision to use Research Engineers International's STAAD.Pro engineering software to model and design the hangar superstructure. Using STAAD.Pro, a preliminary model was developed, and structural members were sized in just two weeks, allowing them to be ordered while the designers completed final design and sizing of the structure. Total time to model, design and size the structure was approximately five weeks, an essential component of the aggressive design and delivery schedule. In total, the US Airways hangar at Philadelphia International Airport was designed, built and occupied in 14 months.

To accommodate building height restrictions imposed by the airport, the structure had a unique configuration sloping from the rear of the hangar towards the doors at the front. The design team chose to use a flat-bottom roof truss scheme that varied the truss depth to create the proper roof pitch. Trusses varied in depth from $13^1/_2$′ above the hangar doors to nearly 35′ at the rear of the building. This framing system kept the bottom chords of the trusses at the same elevation, simplifying the bracing system and providing easy support for the two 5-ton and one 10-ton underhung cranes. The building also had overhangs at each end of the building, which further complicated the framing system. The unique roof slope created the need for a custom interior gutter, located above the hangar doors. The gutter, which is 2′ wide and 8″ deep, was fabricated out of stainless steel.

With the roof pitching down towards the hangar doors, the trusses in this area are the shallowest in depth. However, the hangar doors are very sensitive to roof deflection, with tighter limits on deflection than the remainder of the project to meet the operational tolerances of the hangar doors.

In addition to the main hangar, the maintenance complex includes another 13,375 sq. ft. of ancillary shops and storage areas, and 26,850 sq. ft. of office area located in a two-story structure adjacent to the main hangar. Custom 2″ foam wall panels in three different colors were used in conjunction with a split-face masonry wall for the exterior building cladding. A 10′ tall ribbon of translucent panels runs along three sides of the hangar, allowing natural light into the facility. A custom color MR-24 roof system was used on the hangar and several of the ancillary shop buildings.

Even though design of the project began in October 1999, the first shipments of steel arrived on the site in December 1999. The buildings were constructed throughout the winter and spring of 2000. Because BHS was able

The unique roof slope of the US Airways Hangar meant each of the eight trusses was a different height, ranging from 17′ to 35′ deep, with no two being the same.

to meet the design and delivery schedule, the project construction phase met its commitments, and the hangar was turned over to US Airways in October 2000.

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STEEL DETAILER:
PKM Steel Service, Inc., Salina, KS
(AISC member)

SOFTWARE:
STAAD.Pro