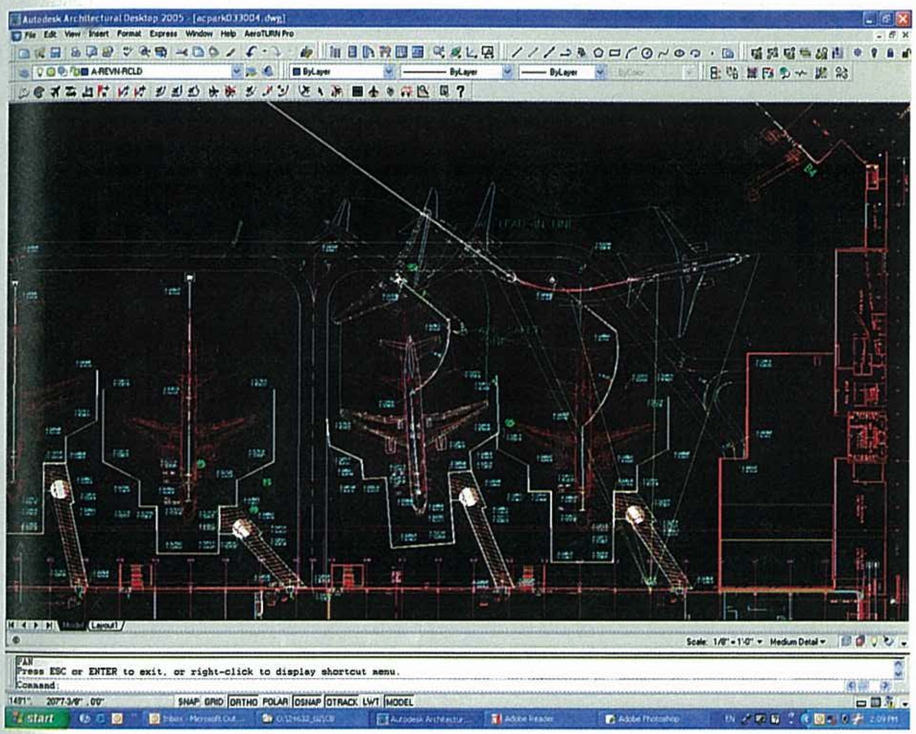
CHANGE HAPPENS

HOW DOES AN ARCHITECT ADAPT A CONCOURSE DESIGN TO A SUCCESSION OF ALTERING REQUIREMENTS?



1. Resolving conflicts with accuracy and efficiency at an inside corner requires aircraft movement simulation

Airport planning is a careful combination of art and science. Furthermore aircraft positioning is the basis of concourse design and its specific design challenges are best described as solving a puzzle with infinite options but only one solution. These adages are exemplified in the case of the South Terminal Expansion Project at Seattle Tacoma International Airport in Washington, USA.

The construction of the airport's Concourse A was designed to flexibly accommodate the activities of several carriers. In all 14 gates were designed to meet the forecast operations of these airlines. As construction began, considerable changes occurred to the list of carriers scheduled to use the facility. Concurrently the events of 9/11 further precipitated dramatic changes by the carriers. The task of re-optimising the gate assignments under the revised demand forecasts, in itself quite a planning challenge, was further complicated by the construction process. Under these circumstances it became vital to provide appropriate solutions with minimum delay. It was apparent that design flexibility would lessen the further construction progressed.

The Seattle Port Authority selected NBBJ to work on this design project in 1997. The company was tasked with adapting the design of the concourse to accommodate a fleet mix and schedule that was quite different from the mix used in the original design. The previous planning study for the concourse had used the Boeing 757 as the design aircraft. This meant that all 14 gates would be capable of servicing this aircraft and the design of the concourse went ahead under this assumption. As the concourse had been designed from the outset to accommodate change the issue was not how to do it, but how to do it quickly.

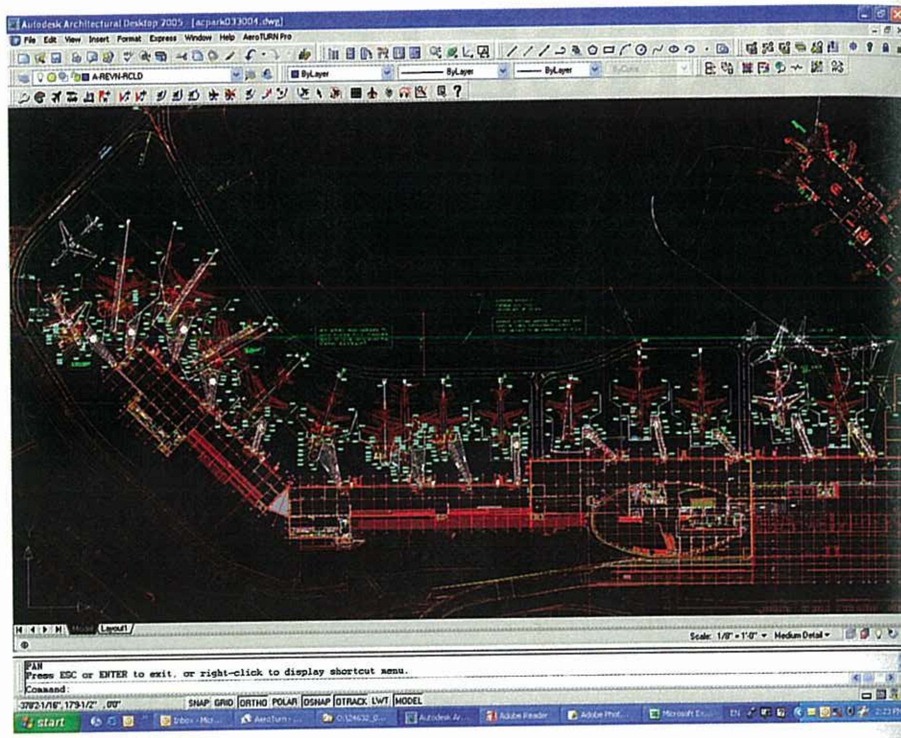
Because concourse design progresses from the accepted plan, gates are assigned to carriers who finalise the desired range of aircraft being parked at each specific gate. Simultaneously the number of parameters required to complete the details of the parking plan increases in complexity. Some of these parameters include adjacent wing-tip clearances, loading bridge slopes, vehicle service road clearances and ground service equipment coordination. Options are explored and a solution is arrived at that satisfies all parameters and the desired aircraft mix. However the effect of 9/11 on the airline industry caused airlines to rethink their service routes and revise their aircraft fleet mix and smaller aircraft had to be accommodated. While parking smaller aircraft was not a challenge in terms of wing-tip clearance, it did pose a challenge in terms of acceptable boarding bridge slopes. Smaller aircraft have a lower sill height, so the bridges needed to extend further out in order to maintain an acceptable slope based on ADA standards.

During document completion and finalising of the airline leases, the aircraft mix changed once more. The airline tenants requested the ability to park larger aircraft such as Boeing's 747 and 777. This request posed a major challenge to fully optimise the parking area of the concourse to allow the greatest variety of aircraft with the least number of inoperable gates. In many cases the larger aircraft could not be accommodated without blocking an adjacent gate or restricting its use to smaller aircraft. Under these conditions an added challenge occurs when the larger aircraft is adjacent to a different airline gate. The final addition of a 777 to gate A8a is a good example of how complex this challenge is.

Originally positioned on gate A7 the 777, would have caused A6 to be inoperable. The problem was that Gate A6 was assigned to one airline and Gates A7 to A9 were assigned to another. The solution was to reposition the aircraft to a split lead-in line, designated A8a, where it would not disrupt operability of another airline's gate and also allow A9 to remain operable.

Modelling and analysing the different adjacency combinations with conventional CAD tools takes a long time. For this project NBBJ used AeroTURN airside simulation and design software from Transoft Solutions as an add-in for AutoCAD. With AeroTURN's sophisticated functions this task was completed in much less time than by conventional methods. The biggest contribution to this saving came from having the equipment characteristics already programmed into the software, thereby eliminating the time-consuming calculation of turning radii and bridge angles. Bridges and aircraft can simply be selected from the library and clicked into place. The process was intuitive and required little, if any, supporting mathematical calculation. The ability to do this within popular CAD tools such as AutoCAD makes the product easy to use.

During the design of Concourse A, an issue developed centring on gates 9, 10, and 11 – situated at an inside corner of the terminal. Gate 10 is controlled by the Port of Seattle and gates 9 and 11 are leased to two different airlines. With both airlines wanting to explore the possibility of adding larger aircraft such as the 747, this situation required a lot of testing of different aircraft placements, bridge angles and most importantly aircraft movements. AeroTURN efficiently resolved this complex situation to the satisfaction of the airlines.



Additionally the configuration and location of the concourse in relation to other airside facilities provide further challenges. In one instance we had to accommodate a 757 on Gate A1, which is controlled by the Port of Seattle. The figure above illustrates that the J line for this aircraft involves a tight inside corner. Evaluating, and then simulating this case, using the animation features in AeroTURN, allowed us to quickly resolve the issue.

In another case the gate location at the end of the concourse placed an aircraft very close to a secure access fence. The airline using the gate was interested in using a 757 on this gate. The challenge was to define the precise movement of the aircraft based on, among other things, whether the jet blast would extend to this fence. The optimal movement was then translated into the painted lead-in line that would instruct the pilot on how to manoeuvre the plane to the gate. During numerous tests of the aircraft movement, AeroTURN's jet-blast settings allowed us to determine that a 757 could be accommodated on this gate. Any larger aircraft would cause jet blast to extend past the fence.

This project showed that a dynamic planning environment requires adaptive design strategies, and successful implementation of these strategies requires the right tools to design, evaluate and demonstrate appropriate solutions. Tools such as AeroTURN, which can be integrated into common CAD applications, provide the speed, sophistication and flexibility to deliver such solutions.

Keith K. Hui is a senior associate with NBBJ in Seattle, Washington

1. Seattle Tacoma International Airport Concourse A – aircraft parking optimised