Case Study

Oasys MassMotion

BEIJING DAXING INTERNATIONAL

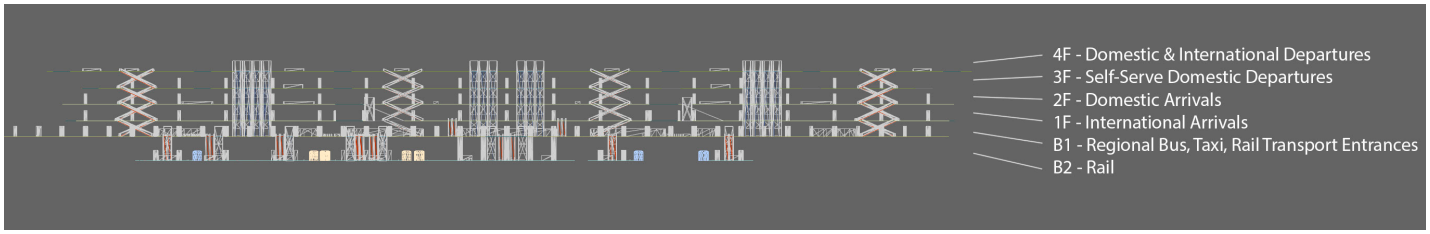
RESOLVING FUTURE PASSENGER FLOW PROBLEMS AT THE WORLD'S LARGEST AIRPORT

Managing increasing passenger numbers is a key priority for airport planners and designers, who can now employ a wide range of software tools, including smart pedestrian simulation to test architectural concepts.

At Beijing's new airport, currently named Beijing Daxing International and due to open in 2019, potential issues have been spotted and resolved years ahead of any passenger setting foot on site. Oasys MassMotion was used integrally with Simeo 3D airport simulation and Elevate to reveal and resolve future passenger flow problems. The new airport will serve 45 million passengers a year once opened, with further works planned to expand capacity to 100 million passengers a year - taking the runway count to four and the terminal size to two million square-foot.

This is the first project in China where crowd simulation was considered to be "a critical component" of the development, and the simulation and analysis part of the project received unprecedented attention from stakeholders. MassMotion added untold value by putting intelligent agents that react dynamically to surrounding events into the simulation. This is as near to the real world and real people as it is possible to get in a simulation.

Beijing's existing Capital International Airport has long been operating over and above its 76 million annual passengers (MAP) capacity. Now the Beijing New International Airport is under construction, with an initial capacity of 45 MAP when it opens in 2019 growing to around 72 MAP by 2025. Arup airport analysts based in Toronto and Beijing and led by Aashabh Misra and Fangzhou Su, started working on the project in March 2015, and the integrated approach they adopted quickly generated intelligence that resulted in several adjustments to the multi-disciplinary design. The 700,000m^2 terminal building designed by Zaha Hadid has six floors: two basement floors for rail, buses and taxis, two floors for arrivals and two for departures, with access to parking areas also provided.



Cross-section of levels modelled in MassMotion

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The project's detailed terminal model, built in Simio 3D, generated passenger flow data which was exported to develop detailed passenger schedules and distributions for MassMotion to analyse and optimise for both the initial 45 MAP and ultimate facility demand of 72 MAP. Particular attention was placed on passenger processing facilities – check in, security, boarding etc.

The MassMotion model provided detailed information on potential bottlenecks. The passenger flow data it generated was used to develop detailed passenger schedules and distributions to help planners avoid congestion. It was, for instance, instrumental in determining the performance of the numerous escalators that span the front face of the terminal building. This was always going to be critical for the building's success, and accurately modelling the behavior of people using the multi-level elevator banks was one of the biggest challenges on this project. Simulations needed to reflect varying demand at each elevator bank for each floor level at different times of day - it was a complex matrix.

To model this, the analysts innovatively developed an integrated approach to create collaboration between MassMotion and Elevate, a leading software tool that is used to test elevator capacity. Passenger profiles were generated in MassMotion for each elevator bank at each floor and exported to Elevate for assessment of elevator performance against anticipated demand.

How the analysis helped create a better airport

Overall, this integrated approach to crowd analysis helped identify – and eliminate - inefficiencies in the building layout early on in the construction process. The highly visual outputs from MassMotion enabled the Arup airport analyst team to demonstrate the effects of suggested design modifications at a stage in the project when they would be relatively inexpensive to implement. The major changes undertaken included the adjusting of the location of the elevators and providing an additional pair of escalators on each side of the terminal facility.

See Figure 3, 4 and 5 for snapshots of the MassMotion model and related analyses.

Notes: The authors of this paper would like to acknowledge Erin Morrow, Micah Zarnke, and Daniel Park of the MassMotion development group for providing continued support and insight in to the development of the passenger congestion model. We would also like to thank Ming Li and Jing Chen from Arup's Beijing office for their support in interfacing with the client during project delivery.

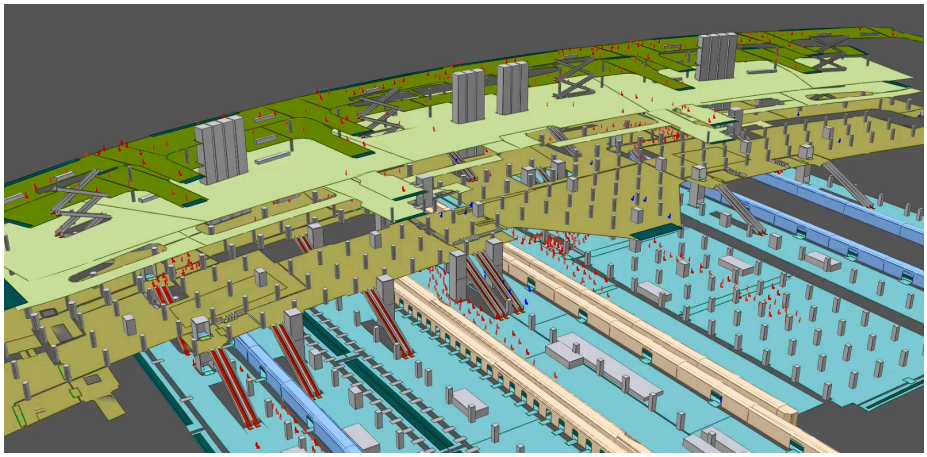

Figure 3 - MassMotion Model – Beijing New International Airport

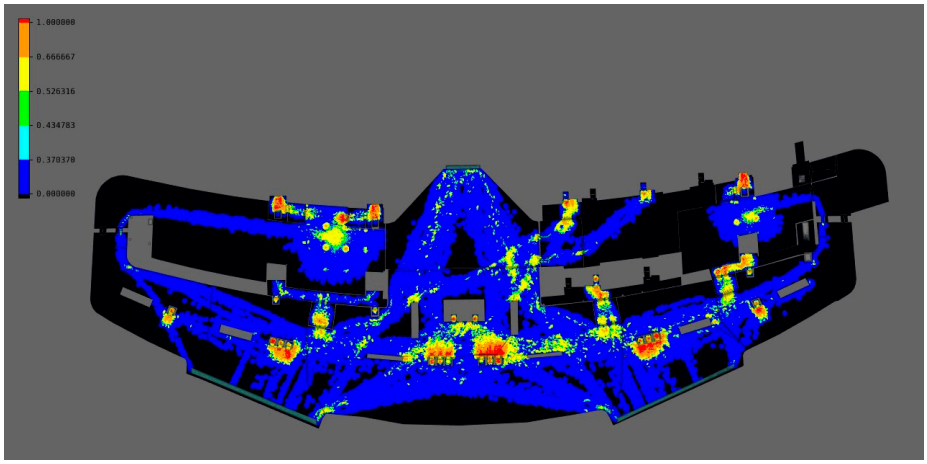

Figure 4 - Pedestrian Density Map used to identify pinch-points in the layout

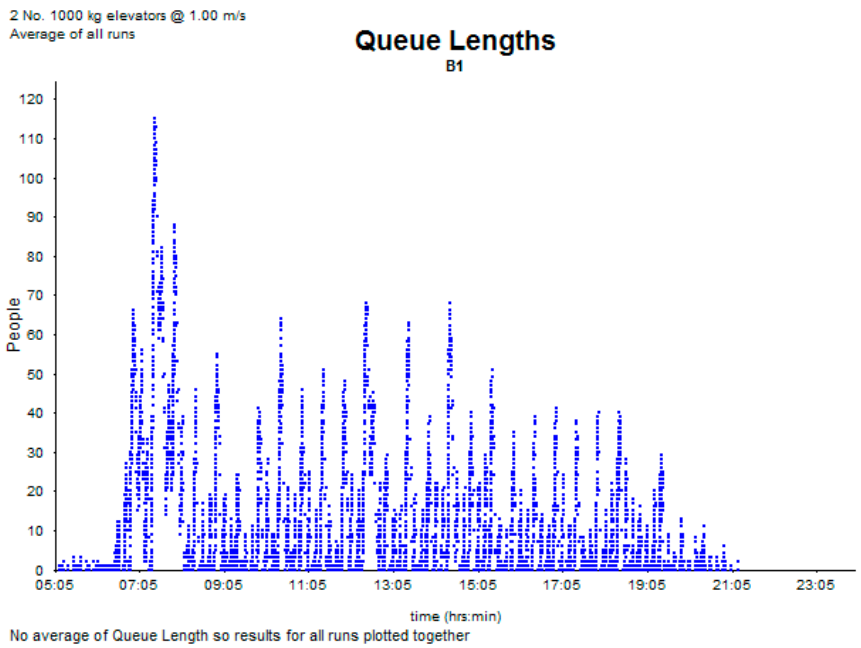

Figure 5 – Estimation of queues at Elevators Banks, Elevate