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Flow Simulations for Airports –Analyzing flow interaction of taxiing aircrafts with buildings and blast fences.

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ABSTRACT

On airports blastfences are used to protect operative staff during loading and unloading, tanking, inspecting and various other duties and responsibilities in the vicinity of taxiing aircrafts. Building claddings have to be protected by blastfences as well since breakaway thrust of modern aircrafts is increasing steadily leading to local velocities sometimes well above safety thresholds. Operational traffic has increased on airports such that aircrafts have to taxi in close proximity of buildings and ground staff.

Using computational fluid dynamics methods [1] the positioning and effectiveness of blastfences on airports is validated. Before simulating the complete 3-dimensional scenario we start with an investigation of the quasi two dimensional cross sectional flow through a single blastfence. Figure 1 shows field contours of the velocity magnitude of a two dimensional flow simulation. Results are compared to specifications given by the manufacturer.

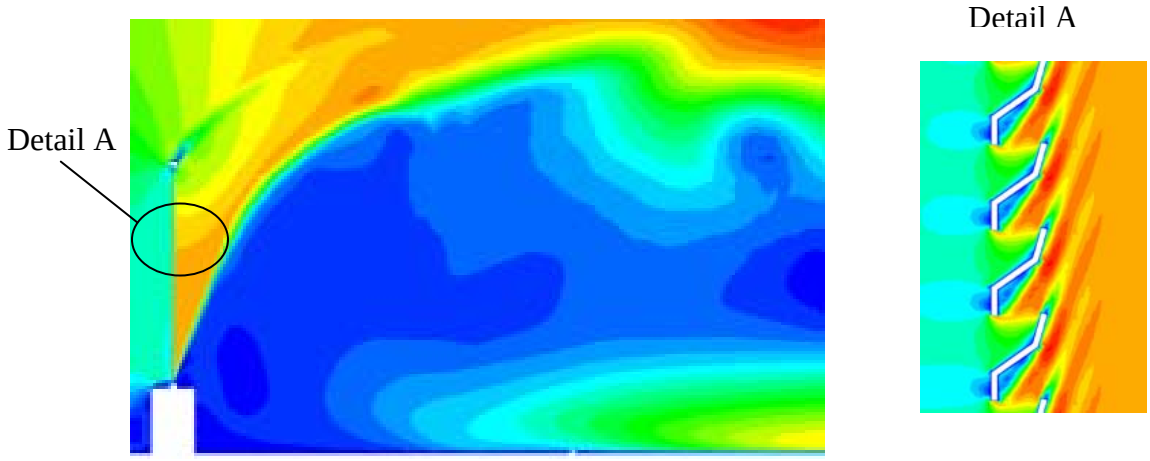

Fig. 1. Velocity magnitude contours of a 2-dimensional cross sectional flow through a blastfence using DES – turbulence model.

Realistic modelling of aircraft characteristics at break-away thrust in terms of velocity and temperature distributions behind the aircraft is performed by implementing an inlet boundary condition for compressible flows according to the aircraft manufacturer data sheets [2].

Isolines of the velocity magnitude from a 3-dimensional flow simulation of the airport are depicted in fig. 2. Flow simulations are carried out for different positions of the aircraft relative to the airport building with and without blastfences.

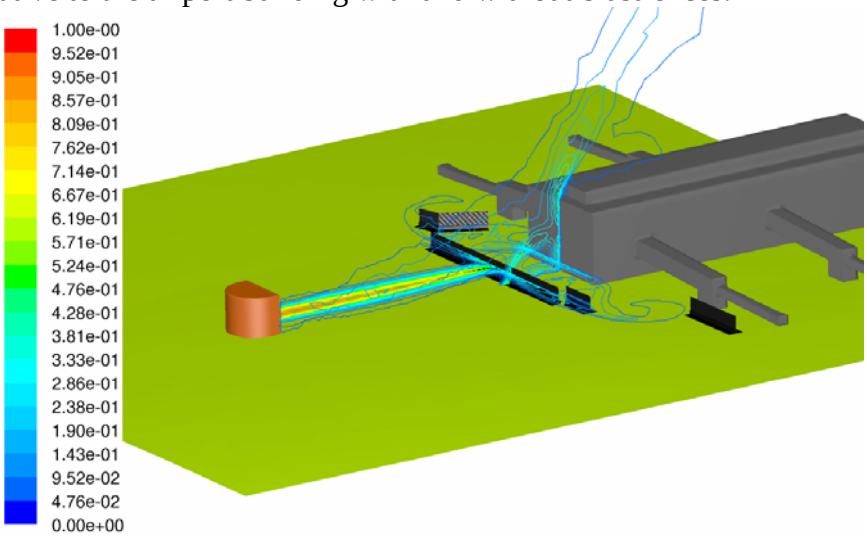

Fig. 2. Isolines of velocity magnitude in dimensionless form from a 3-dimensional flow simulation with installed blastfences for an aircraft MD-11 at break-away thrust directed straight against the airport building.

Analyzing vortex dynamics generated by the flow deflection in the blast fences is done by using different vortex detection methods [3] implemented in our advanced graphical interactive tools [4]. Its use and range of application will be explained.

The presentation is focussed on the effective use of flow simulation methods and analysis tools for airport design relevant issues. The effectiveness and positioning of blastfences is easily validated using advanced numerical simulation tools compared to expensive testing on manoeuvring areas. Results include vortex analysis, velocity and pressure distributions at critical positions as well as pressure distributions on buildings, supporting the work of airport designers and architects.

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