EX179

Blast Deflector

In this example, FLUENT 5 is used to study the flow produced by an aircraft engine on a runway that is adjacent to a street. If unperturbed, the exhaust jet is shown to cause strong winds that could impact the nearby street traffic. By introducing a blast deflector, the exhaust jet can be deflected away from the street. The deflector is shown to cause secondary vortices, however, suggesting that design modifications are warranted.

Airport authorities often need to protect nearby roadways and adjacent areas from the exhaust blasts of large aircraft engines. Blast deflectors and other similar devices are generally placed at the end of the runway to deflect these blasts up and away from the roadway. In this example, FLUENT is used to simulate one such situation in which blasts from airplane engines were passing directly over an adjacent street. CFD was used to predict the resulting wind conditions on the street, and subsequently, to predict the wind conditions when a blast deflector was added.

This simulation considered a 640,000 square foot area around the engines of a B-767 aircraft. Figure 1 shows the region before the blast deflector was added. The runway is elevated 20 feet above the street, and the only protection between the runway and street is a short retaining wall. The ground terrain surrounding the aircraft was modeled in GAMBIT using the available digitized contour data of the area. The domain was assumed to be symmetric about the mid-plane of the aircraft, halfway between the two engines.

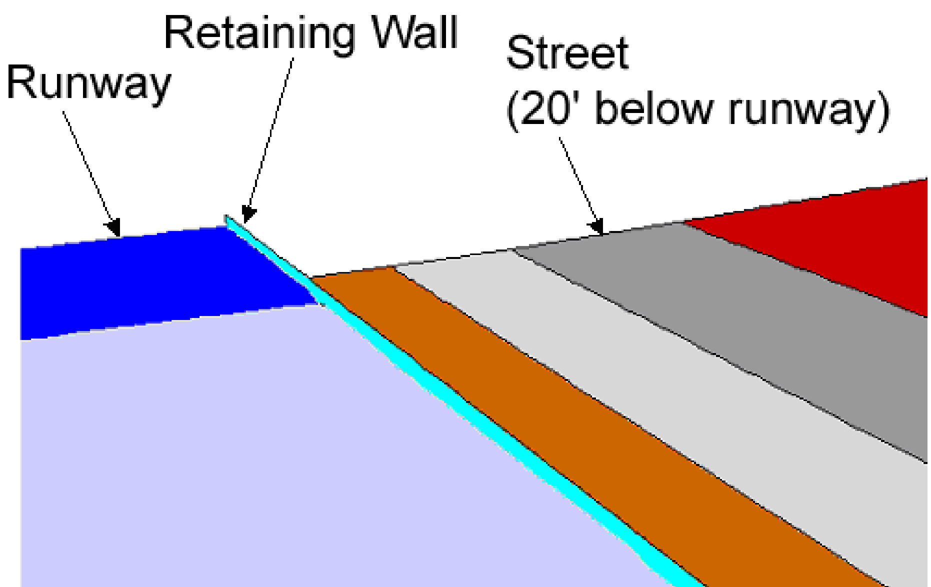

Figure 1:The area near the aircraft, consisting of the runway and adjacent roadway

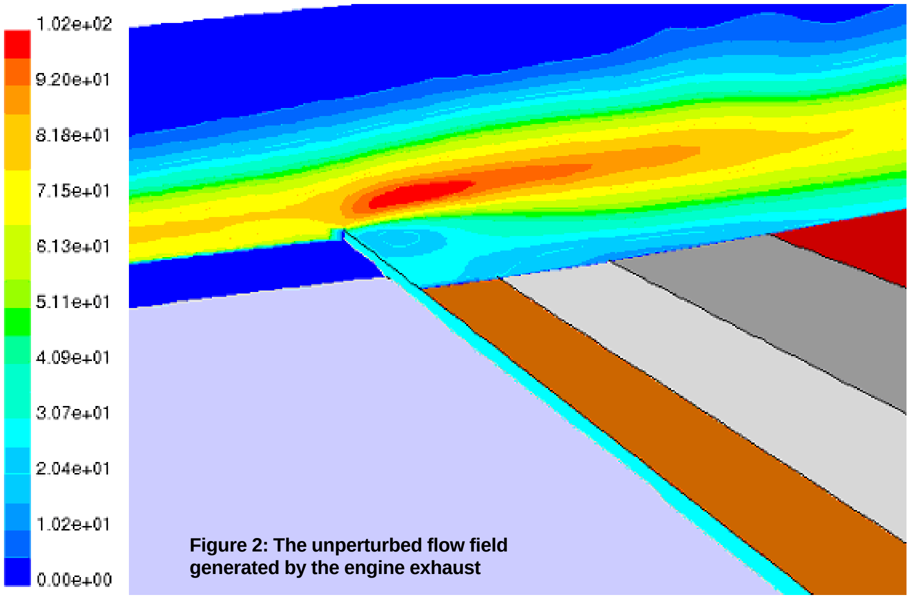

Figure 2: The unperturbed flow field generated by the engine exhaust

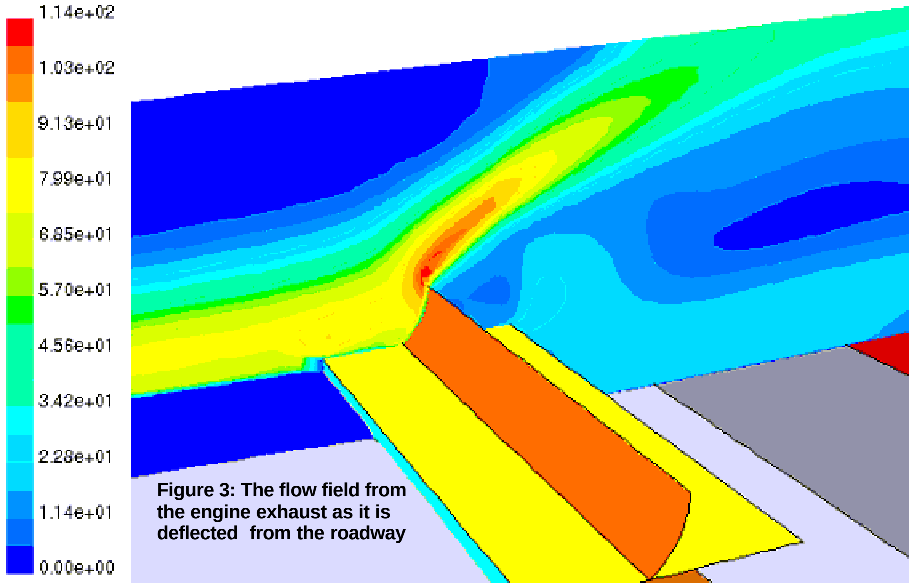

Figure 3: The flow field from the engine exhaust as it is deflected from the roadway

The exhaust from the engine was modeled as a velocity inlet boundary. The k-ε model was used for the turbulent simulation. A mesh of 765,000 hexahedral cells was employed.

Figure 2 shows contours of velocity magnitude in the vicinity of the nearby street with maximum exhaust conditions, but without the protection of the blast deflector. From the ground up to the height of the runway there is a strong gradient in the wind speed, which reaches a maximum of 80 - 100 mph. Without protection, street traffic would encounter winds of this magniutde when an aircraft takes off from the runway.

The blast deflector in Figure 3 (orange and yellow) shows how the strong wind gusts can be deflected up and away from the street by this device. In addition to reducing the magnitude of the wind at street level, the deflector acts to reduce the gradient in the wind speed as well.

Figure 4 is a view from the street towards the back side of the blast deflector. Because of the strong jet of air passing over the center of the deflector, air from below the deflector is entrained, forcing the development of a pair of transverse, counter-rotating vortices, as shown. While the air currents on the street are improved by the deflector, the introduction of the vortices, which themselves contain moderately high speed flows (30 - 50 mph), suggests that additional protection would be necessary to avoid damage from these secondary effects. Path lines in Figure 5 are used to illustrate the flow emanating from the engines and passing over the deflector, where the vortices are generated.

In summary, FLUENT has been used to study the trajectory of an exhaust jet from an aircraft engine. In one case, the jet is allowed to freely travel off the runway and out into the vicinity of a nearby street, causing high winds and steep velocity gradients. In a second case, a blast deflector is used to redirect the exhaust jet, thereby calming the conditions on the street. The blast deflector does cause the formation of a pair of counter-rotating vortices, however, and this result suggests that modifications to the deflector design are warranted. *Courtesy of HTA, Inc.*

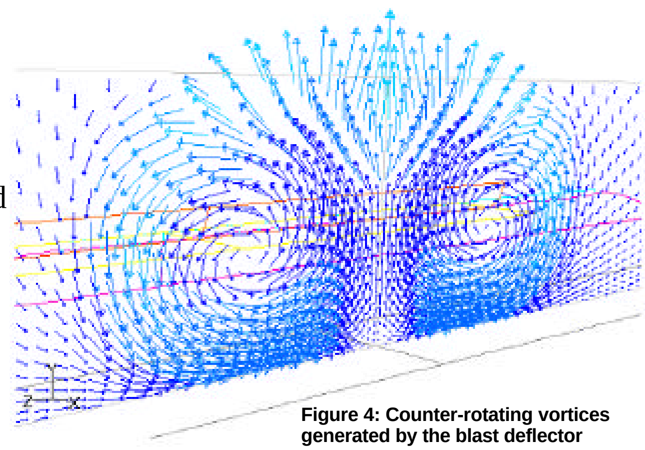

Figure 4: Counter-rotating vortices generated by the blast deflector

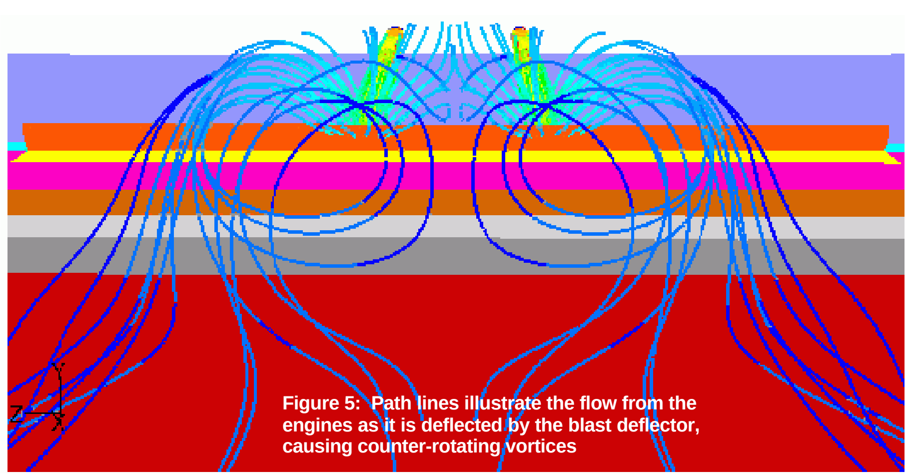

Figure 5: Path lines illustrate the flow from the engines as it is deflected by the blast deflector, causing counter-rotating vortices