Vortex Generators

Since the condition of the boundary layer on an object, whether laminar or turbulent, can have a profound effect on the location of separation of that boundary layer and therefore on the drag on that object, it is natural that devices have been invented that try to promote transition to turbulence and therefore delay separation and thus decrease the drag. The most common of these devices are small projections called "vortex generators" that are often installed on the suction surfaces of airfoils. Both the precise location and, to a lesser extent, the size and shape of these projections are important in achieving the objective. They need to placed beyond the region of accelerating flow on the surface where the disturbances they create would be attenuated by the stable boundary layer but before the point where the laminar boundary layer might separate. Moreover they need to be large enough to project beyond the laminar sub-layer and thereby disturb the most unstable strata in the boundary layer. They probably only work in a range of Reynolds numbers close to the Reynolds number at which drag crisis would occur without them. Figure 1 (left) shows a row of triangular "vortex generators" affixed to the suction surface of a commercial airliner wing. Figure 1 (right) shows the vortex generators affixed to the helmet of the 2010 Olympic Champion in Women's Skeleton, Amy Williams. Whether they gave her any competitive advantage might be open to question; however it is notable that the Reynolds number associated with the helmet during a skeleton run is close to that of drag crisis.

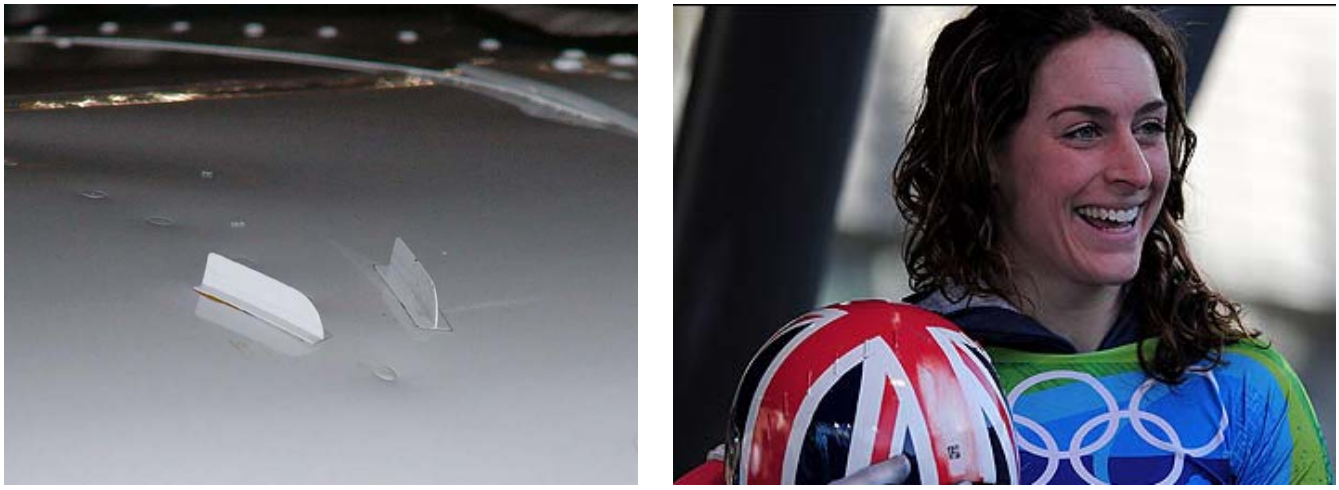

Figure 1: Left: Vortex generators on an aircraft wing. Right: Amy Williams, the 2010 Olympic Champion in Women's Skeleton, with a helmet equipped with vortex generators.

We also note that the deliberate tripping of transition of a laminar boundary layer plays a large part in many sports as described in more detail in section (Dbh).