The 10th TSME International Conference on Mechanical Engineering
10th – 13rd December 2019
Pattaya, Thailand

Effect of Variation of Aerodynamic Brake Plate Orientation on Incident Drag of Hyperloop Pod

S Mahmud[1], S S Khan[2], A Adnan[3] and M H Rahman[4*]
[1,2,3,4] Department of Mechanical and Chemical Engineering,
Islamic University of Technology, Gazipur, 1704, Bangladesh

[4*] Corresponding Author: mhrahman@iut-dhaka.edu

Abstract. The idea for the Hyperloop has received significant attention, with commentators and analysts expecting it to become a revolutionary and potentially the fastest mode of land transportation on the planet. Multiple studies have been carried out using numerical simulations to obtain insights into the different factors affecting the Hyperloop's performance. The low-pressure tube through which the Hyperloop pod travels is subject to flow with high Reynolds number, presenting a case that has not been faced in the other transport models. The Hyperloop pod is expected to travel at speeds close to Mach 1.0, and as such accelerating and decelerating of the pod is of critical importance if passenger safety protocols are to be maintained. The high-speed flow around the pod exerts high adverse pressure gradients on the pod surface, resulting in boundary layer separation, increasing drag and affecting the acceleration of the pod and requiring greater power. Numerical simulations have shown that the placement of an aerodynamic brake plate on the pod surface at the point of boundary layer separation in the low-pressure region provides the necessary drag required for safe deceleration, as well as provide the required down force to counteract the lift forces, which become significant due to the low-pressure regions above the pod, enabling the pod to stay on the track. This study was aimed to find the best angle for the aerodynamic brake plate positioned at a fixed point of 0.24 of the chord length of the pod, allowing for the optimum generation of drag force, using numerical simulations. Analysis of several brake configurations found that placing the plate normal to the flow produced the highest drag, with a singular exception; orienting the brake plate in the backward direction, i.e. away from the fluid flow while increasing its length to keep incident brake profile constant resulted in the incident drag to initially increase with increase in angle with respect to axis of flow, and then decrease.

Keywords: aerodynamics, cfd, compressible flow, numerical analysis, turbulence.