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Effect of Halo Protection Device on the Aerodynamic Performance of Formula Racecar

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Abstract : This paper explores the aerodynamics of the formula racecar when a ‘halo’ driver-protection device is added to the chassis. The halo protection device was introduced at the start of the 2018 racing season as a safety measure against foreign object impacts that a driver may encounter when driving an open-wheel racecar. In the one-year since its introduction, the device has received wide acclaim for protecting the driver on two separate occasions. The benefit of such a safety device certainly cannot be disputed. However, by adding the halo device to a car, it changes the airflow around the vehicle, and most notably, to the engine air-intake and the rear wing. These negative effects in the air supply to the engine, and equally to the downforce created by the rear wing are studied in this paper using numerical technique, and the resulting CFD outputs are presented and discussed. Comparing racecar design prior to and after the introduction of the halo device, it is shown that the design of the air intake and the rear wing has not followed suit since the addition of the halo device. The reduction of engine intake mass flow due to the halo device is computed and presented for various speeds the car may be going. Because of the location of the halo device in relation to the air intake, airflow is directed away from the engine, making the engine perform less than optimal. The reduction is quantified in this paper to show the correspondence to reduce the engine output when compared to a similar car without the halo device. This paper shows that through aerodynamic arguments, the engine in a halo car will not receive unobstructed, clean airflow that a non-halo car does. Another negative effect is on the downforce created by the rear wing. Because the amount of downforce created by the rear wing is influenced by every component that comes before it, when a halo device is added upstream to the rear wing, airflow is obstructed, and less is available for making downforce. This reduction in downforce is especially dramatic as the speed is increased. This paper presents a graph of downforce over a range of speeds for a car with and without the halo device. Acknowledging that although driver safety is paramount, the negative effect of this safety device on the performance of the car should still be well understood so that any possible redesign to mitigate these negative effects can be taken into account in next year’s rules regulation.

Keywords : automotive aerodynamics, halo device, downforce. engine intake
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