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INVESTIGATION OF FLOW STRUCTURE BEHIND A MODELED VEHICLE WITH AND WITHOUT SPOILER VIA PARTICLE IMAGE VELOCIMETRY METHOD

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In fluid dynamics in respect of vehicle aerodynamics, flow separation, vortex structures, boundary layers on vehicle surfaces and forces that are realized due to these phenomena are of interest of recent studies. Some of these studies utilize Reynolds Analogy in order to use experimental similarity approach for determining flow characteristics via a relatively easy to operate open water flow channels.

The three-dimensional vortex structures formed in the wake region downstream of a road vehicle and the change of the structures by the effect of a spoiler were investigated using dye visualization and the particle image velocimetry techniques. The measurements were carried out in open water channel for specific Reynolds number values based on the vehicle length and several visualization planes parallel to the free stream flow were used to obtain more detailed flow fields. All these measurements provide a detailed quantitative description of highly complex and time dependent nature of the flow around vehicle with and without a spoiler. Flow characteristics have been examined in terms of the 2-D instantaneous and time-averaged velocity vectors and streamlines, patterns of vortices, RMS of velocity fluctuations and Reynolds stress variations and discussed from the point of flow physics, vortex formation in both cases with and without a spoiler. The results show significantly different flow structures in the recirculation region for the presence of the spoiler. The foci, reattachment and the saddle point, appearing in the wake, form differently along the downstream. The recirculation zone with the spoiler is longer and narrower than without the spoiler. Moreover, the spoiler installed on the vehicle diminishes peak magnitudes of the flow characteristics and thus it is expected that the flow-induced forces will be lessened which contributes to the driving stability.

Keywords: Dye visualization, flow characteristics, PIV, spoiler, vehicle aerodynamics.

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