DRAG REDUCTION OF HEAVY VEHICLES USING VARIOUS SIDE SKIRTS

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ABSTRACT

There are many attempts to save the cost of transportation. Especially, drag reduction of heavy vehicles such as truck or tractor-trailer have enormous effect on the reduction of fuel consumption and CO₂ emission, because road freight transport using heavy vehicles occupies majority in physical distribution cost.

Side skirts are automotive accessories installed at the lower sides of heavy vehicles. Basic role of the side skirts is to prevent accidental incursion into the underbody space of the vehicle. In addition to the safety function, the side skirts control the air flow passing through the underbody of heavy vehicles. The underbody air flow colliding tires or other undercarriage structures can induce aerodynamic resistance, structural vibration and aeroacoustic noises. Such adverse effects can be reduced by controlling the underbody air flow effectively.

In this study, we conducted wind tunnel experiments for scale-down heavy vehicle models to evaluate the effects of various side skirts on the drag reduction of heavy vehicles. Scale-down models of 3 different heavy vehicles (5 ton truck, 15 ton truck and 40 feet tractor-trailer) were tested in this study. Each vehicle model was installed at the test section (1.8×1.5×4.5m) of POSTECH closed-type subsonic wind tunnel. Scale down ratio of the vehicle models is ranged from 1/8 to 1/6 to retain the blockage ratio less than 10%. Drag force acting on each model was measured by using a 7 component balance. Drag coefficients (C_D) of the standard vehicle models without any drag-reducing automotive accessories, the vehicle models attached with commercial flat side skirts and the vehicle models installed with various modified side skirts were compared and their aerodynamic performance was analyzed for each type of heavy vehicles.

Among the modified side skirts tested in this study, the side skirt with a frontal flap folded inward at a specific angle (θ=30~45°) exhibit the most distinguished improvement in drag reduction. In addition, the underbody skirt inclined upward also shows remarkable drag reduction. Interactive effects of these side skirts with boat tails attached at the trailing edge of the vehicle models were also investigated. Since the boat tail controls the rear wake of the vehicle, the drag-reduction effect of the boat tail and the underbody air flow affected by side skirts interfere in the aerodynamic performance of the vehicles.

The ultimate goal of this study is to find the most efficient configuration of the skirt-type automotive accessory to reduce the aerodynamic drag of three representative heavy vehicles, which leads to the maximum reduction of fuel consumption and CO₂ emission.

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