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Occupant Injury of Minicar in Side Collision with Passenger Car

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A minicar which is micro mobility vehicle is expected to play an active role in the future. Because it is small size, maneuverability, and ease of driving make it suitable for delivery or commercial vehicle. The minicar is most frequently involved in side collisions in traffic accident statistic. However, any side collision tests for minicar has not been conducted in regulations and vehicle assessments. The purpose of this study is to examine the crashworthiness of a passenger car versus a minicar in side collision and to clarify a method for reducing a occupant injury.

Car body deformation and occupant lumbar acceleration were measured by conducting side collision test of a passenger car and a minicar (Fig.1). Fig.2 shows that the body deformation of the minicar was concentrated on the B pillar slope and Upper frame. High acceleration was observed in the occupant's lumbar, which indicates a high risk of lumbar injury.

A CAE model was constructed to reproduce the actual crash test. There were calcurated for acceleration (Fig.3), vehicle deformation, and occupant lumbar acceleration to confirm a reproducibility with the actual vehicle crash test. The pubic bone load, the injury index for the occupant's lumbar, was calculated from CAE analysis, and the value exceeded the threshold value of 6.0 kN, confirming that the injury was high. It also checked the minicar's von-Mises stress and confirmed that the stress was concentrated in the B pillar slope and Upper frame (Fig.4).

To reduce the occupant lumbar injury value, the side structure of the vehicle body was modified and the diameter of the member was changed to increase the bending rigidity. As a result (Fig.5), it confirmed that the occupant lumbar injury value decreases to 38 mm (Condition 4) in diameter, but that the occupant lumbar injury value increases when the diameter exceeds 41 mm (Condition 5). It is also confirmed that the load can be transferred to the front of the vehicle by changing the side structure.

Fig.1 Collision test (33 km/h)

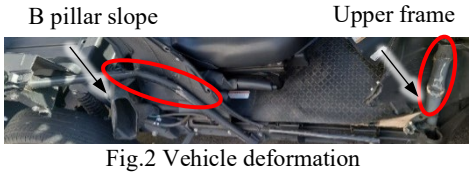

Fig.2 Vehicle deformation

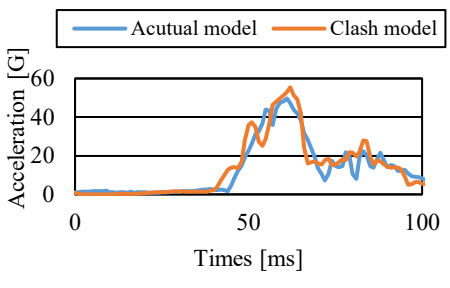

Fig.3 Minicar Acceleration

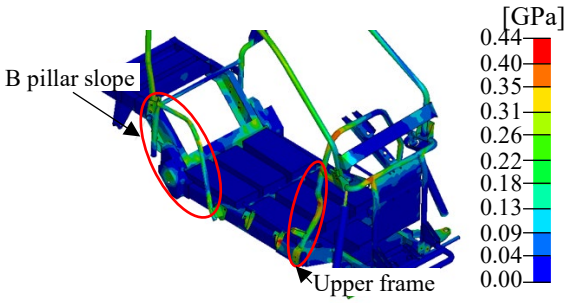

Fig.4 Von-Mises stress of the minicar body at maximum pubic load

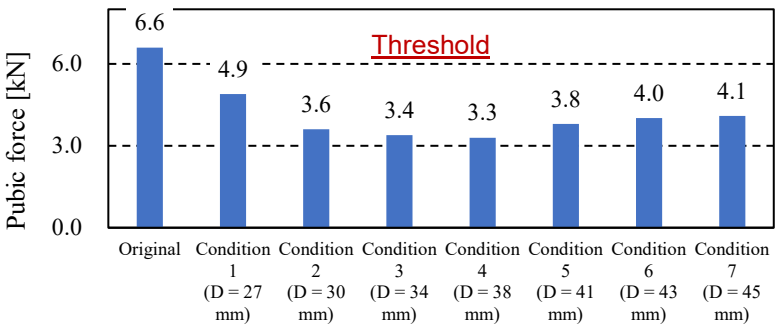

Fig.5 Comparison of pubic force