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Impact of Vibration Applied to the Vehicle by the Hub Nut Clamp Type Vehicle Restraint Device (Second Report)

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The cause of vibration applied to the vehicle by the hub nut clamp type vehicle restraint device was clarified through both theoretical analysis and experimental analysis. Also, it was confirmed that the vibration damper installed at the anti-node point of high center pitching mode can be practically reduce the vibration even in a state in which noneccentricity of the hub nut flange cannot be completely accomplished.

In the theoretical analysis, 3-DOF(Degrees Of Freedom) vibration model for the vehicle was used to determine eigenvalue and eigenvector of vibration whether with the hub nut clamp type vehicle restraint device or not. Since eigenfrequency of high center pitching mode is higher than the that of the low center pitching mode, the high center pitching mode vibration makes a trouble in driving cycle operations. To suppress the high center pitching mode of vibration which is different from the actual driving on the road, it is essential that the eccentricity of the hub nut flange be made as close as possible to zero. However, using a vibration damper on the vehicle was considered to reduce its resonance amplitude when it is difficult to make the concentricity very close to zero in some cases.

A vibration analysis simulation model of the vehicle was created to consider the effect of installing a vibration damper on the vehicle. From the simulation results shown in Figure 1, it was confirmed that vibration is reduced by installing a vibration damper on an anti-node point of the high center pitching mode.

In the experimental analysis, a test vehicle was used to consider the effect of installing a vibration damper on the vehicle. Figure 2 shows a state in which a vibration damper is mounted on the rear towing hook of the test vehicle. Similarly to the motion analysis simulation model of the vehicle, measurements were performed with an accelerometer installed within the trunk of the test vehicle. Also, evaluations were performed at the vehicle speed of 30 km/h for comparing the vibrations during steady state run. It was confirmed that installing a vibration damper is effective even if with the some of eccentricity of the hub nut flange.

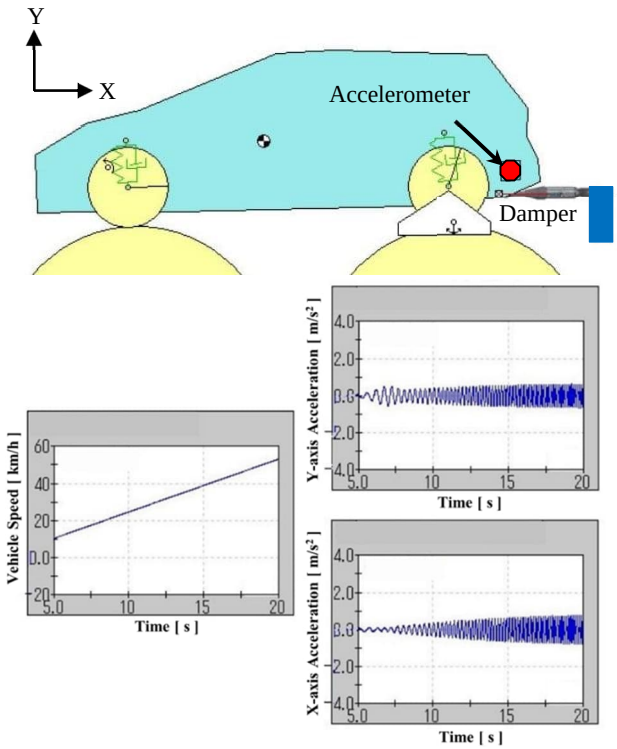

Fig.1 Simulation of the Vehicle with Damper

Fig.2 The Damper Implementation