

VEHICLE SAFETY STANDARDS REPORT (VSSR) 1

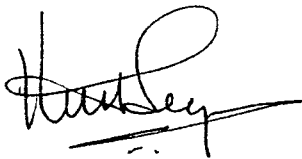
Vehicle Design and Operation for Pedestrian Protection - Accident Simulations and Reconstructions

Please find enclosed a copy of VSSR 1 *Vehicle Design and Operation for Pedestrian Protection - Accident Simulations and Reconstructions*. This report was commissioned by the Department of Transport and Regional Services as part of its research program to improve pedestrian safety.

The report details the reconstruction of a number of real world impacts between pedestrians and cars. The principal aim of performing the reconstructions was to examine how injuries sustained by pedestrians in real life relate to the results of reconstruction tests that used the impactors designated by the European Enhanced Vehicle-safety Committee (EEVC) for assessing pedestrian protection. The main finding was that the head impact test designated by the EEVC is a sound predictor for severe head injury in actual pedestrian collisions, as measured by the Abbreviated Injury Scale.

The information in this report is being disseminated to the International Harmonised Research Activities (IHRA) working group on pedestrian safety.

If you have any queries regarding the report please contact Mr Craig Newland on 02-62747923.

A handwritten signature in black ink, appearing to read 'Keith Seyer', with a horizontal line underneath.

Keith Seyer
Chief Engineer
Research, Audit and Vehicle Recall
10 April 2003

Executive Summary

This report details the reconstruction of impacts between pedestrians and cars. The principal aim of performing the reconstructions was to examine how injuries sustained by pedestrians in real life relate to the results of reconstruction tests that used the impactors designated by the European Enhanced Vehicle-safety Committee (EEVC) for assessing pedestrian protection.

The methodology of this study included accident investigation, computer simulation, and the physical reconstruction in a laboratory of impacts that occurred in the accident cases that were investigated. The accident investigation process provided the impact speed of the vehicles in each case, details of the contact between pedestrian and car, and the resulting injuries. This information was used to simulate the car-pedestrian collision in each case using the computer program, MADYMO. The simulation of the collision reproduced the kinematics of the pedestrian in the collision and provided estimates of the conditions of the impacts between the car and the pedestrian's leg, upper leg and head. Specifically, the simulation provided the relative angle and velocity of the head with respect to the car, just prior to impact. It also provided the relative angle, velocity and effective mass of the upper leg prior to impact. The striking speed of the vehicle was used as an estimate of the relative velocity of the lower leg on impact.

Ten pedestrian accidents were selected from a pool of 80 cases that had been previously investigated by the Road Accident Research Unit. The head impact from every case was reconstructed, and a total of 10 leg impacts were reconstructed in the manner described above. The results of each simulation were used to set the impact conditions of the EEVC subsystem impactors. A car of the same make, model and series as the car involved in the accident was used in the physical reconstruction of the impact, and the impact point on each vehicle was the same as the one identified on the case vehicle by the accident investigation. The results of the impact reconstructions were then compared to the severity of any injury caused by the associated impact in the accident.

The main findings were that the head impact test designated by the EEVC is a sound predictor for severe head injury in actual pedestrian collisions, as measured by the Abbreviated Injury Scale. Impacts that exceeded the acceptable limit of a HIC value of 1000 were positively associated with head injuries that were AIS3 or above ($p = 0.0238$, by Fisher's exact test).

The results of the leg impact reconstructions were more equivocal. The acceleration of the lower section of the EEVC WG10 Full Legform appears to be positively associated with the severity of any fractures of the tibia and fibula. However, the bending and shearing of the knee joint in the legform does not appear to relate to the presence of ligamentous damage to the knee. At this stage, too few Upper Legform tests have been used to reconstruct upper leg impacts, to make any firm conclusions regarding the accuracy of this test.

We recommend that consideration be given to further evaluation of the subsystem impactors and their associated test methods. This report contains results that support the use of the Headform test for the evaluation of pedestrian protection, but further research is needed to assess the appropriateness of the Full and Upper Legform tests.