

CRASH ANALYSIS OF A TYPICAL PICKUP TRUCK UNDER NCAP/IIHS STANDARDS AND CORRESPONDING OCCUPANT RESPONSES

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ABSTRACT

The CAE studies in recent years have focused on the development of safe vehicle structures that meet ever-increasing customer and governmental expectations. In addition, the development of "world trucks" has required automakers to meet safety requirements for the world market. Although much progress has been made in the field of passenger safety in cars and trucks in the last years, there is still a strong need for the design of a more crashworthy vehicle in a frontal collision. So evaluation of crash test performance of each vehicle and how well the vehicle protects the front-seat passengers in a head-on collision is of utmost importance. Over the past twelve years, the modeling of components and crash analysis of entire vehicles have become increasingly significant.

This paper describes the results of a non-linear finite element computer simulation using a Chevy-1500 pickup truck model in a frontal collision for a full width rigid barrier and an offset deformable barrier. These simulations are conducted under the New Car Assessment Program (NCAP) and the Insurance Institute for Highway Safety (IIHS). The simulations are obtained using LS-DYNA3D crash code. The rigid barrier, deformable barrier, airbag and the FE belts are modeled in MSC/PATRAN. The accelerations at various points in the model are recorded. The occupant compartment intrusions are studied and compared in both full-width and offset crashes. Finally the responses of an occupant for the above crash tests are analyzed using the Mathematical Dynamical Model (MADYMO) code and using accelerations generated during LS-DYNA simulations of the car model. The car interiors, which include the seat, steering and floor of the Chevy Truck FE model, are remodeled in MADYMO. A Hybrid III 50th percentile male dummy is used to study the occupant responses. The accelerations obtained from the LS-DYNA crash analysis are given to the system and the occupant responses are recorded. The head accelerations are plotted and the Head Injury Criteria (HIC) values are calculated along with other injury parameters. For the offset crash test the occupant foot injury during compartment intrusion is evaluated by calculating the tibia index and the tibia forces. The MADYMO results are validated by comparing the injury parameters with actual test results of 35 mph crash conducted by NHTSA. Results indicate that the truck fares well in both the full width and offset crash tests, the integrity of the occupant compartment is maintained in the full-width test. The occupant

survives the crash and is not injured severely except for the foot injuries acquired in the offset crash. Finally a methodology is developed for crash scenario.