

FULL-WIDTH AND OFFSET FRONTAL CRASH ANALYSIS OF A FORD TAURUS AND CORRESPONDING OCCUPANT RESPONSES

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ABSTRACT

Safety is of paramount importance to manufactures of roadway vehicles. Although much progress has been made in the field of passenger safety in a car in the last years, there is still a strong need for the design of a more crash worthy vehicle in a frontal collision. Therefore, a vehicle crash test performance and how well the vehicle protects the front-seat passengers in a head-on collision is an essential part of the design of the vehicle. Over the past twelve years, the modeling of components and crash analysis of entire vehicles have become increasingly significant. In this research, a Ford Taurus model is analyzed in a frontal full-width and offset impact.

This thesis describes the results of a non-linear finite element computer simulation using a Ford Taurus 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 model is validated by comparing it with the actual full-scale test results. The simulations are done using LS-DYNA3D crash code. The full-width rigid barrier and the offset deformable barrier 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 Dynamic Modeling (MADYMO) code and utilizing accelerations generated during LS-DYNA simulations of the car model. The car interiors of the Ford Taurus FE model are remodeled in MADYMO. A Hybrid III 50th percentile male dummy is used to study the occupant responses. The finite element (FE) lap and shoulder belt are modeled and a pre-simulation of the belts is done to remove slackness and to determine the exact initial position of the seat belts. The FE airbag is deployed in the steering column, which is triggered by time function. The accelerations got from the LS-DYNA crash outputs are given to the system and the occupant responses are recorded. The MADYMO model is validated by comparing the responses with actual test results of a 30 mph NHTSA crash test method. The head accelerations are plotted and the HIC values are calculated. For the offset crash test the occupant foot injury during compartment intrusion is evaluated by calculating the tibia index and the tibia forces. The full-width and offset crash test results are compared and

the results showed that in both the cases there is no injury to the head. But in the offset crash test the results showed that there is severe leg injury.