

ROLLOVER ANALYSIS OF LIGHT PICKUP TRUCK AND CORRESPONDING OCCUPANTS RESPONSES IN VARIOUS ROLLOVER SCENARIOS

By

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ABSTRACT

This thesis simulates and studies four different rollover analyses, with seatbelt and without seat belt, and they are: 1) Dolly test 2) Embankment 3) Curb Trip and 4) Corkscrew rollover using Mathematical Dynamical Model (MADYMO) code. The main areas of interest of this thesis are: (a) analysis of the occupants responses (kinematics) obtained from MADYMO simulation, (b) evaluation of the different injury criteria like Head Injury Criteria, Chest acceleration and deflection, Neck loads and moments and thus resultant Nij values and (c) evaluation of effectiveness of the restraint systems like the seat belts in attenuating the injuries incurred by occupants.

This thesis also describes the results of a non-linear finite element computer simulation using a Chevy-1500 pickup truck model for a static test and dynamic roof crush resistance test. These simulations are conducted under the Federal Motor Vehicle Safety Standard (FMVSS) 216 and Society of Automotive Engineers (SAE) J996 respectively. The simulations are obtained using LS-DYNA3D crash code.

The whole FEM Chevy-1500 pickup truck is converted into facets surfaces in MADYMO. As seen in the previous study conducted [7], it is better to use the Hybrid III 50% dummy as it shows higher levels of injury values compared to Hybrid II dummy. So Hybrid III 50th percentile male dummy is used to study the occupant responses as its biofidelity response is better. The nodal displacement of the roof structure obtained from the LS-DYNA crash analysis are given to the MADYMO by prescribed structural motion and the occupant responses are recorded. The MADYMO results for the dolly rollover tests are validated by comparing the injury parameters with actual test results of dolly rollover test conducted by NHTSA [8].

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Results from finite element analysis indicate that the truck's roof crushes within the specified FMVSS216 standards. MADYMO analysis of four different rollover scenarios indicates that chances of ejection and thus injuries are reduced to great risk if occupant is belted. But in some analysis it also showed that even if occupant is belted injuries are severe due to direct impact of head with ground and to the deforming roof.