A Process of Decoupling and Developing Optimized Body Structure for Safety Performance

John M. Madakacherry
Technical Specialist, General Motors

Dr. David Eby
Sr. Project Engineer, CD-Adapco

Martin B. Isaac
Manager, General Motors

Dr. Akbar Farahani
Director of Engineering, ETA, Inc.

Dr. Charles A. Bruggeman
Manager, General Motors

Dr. Ron C. Averill
President, Red Cedar Technology

Abstract

A large class vehicle meeting NCAP front crash and 40-mph 40% Offset Deformable Barrier (ODB) Impact performance was modified and tested to verify a new load path strategy using hydroformed structure and new analytical tools to reduce the mass of the vehicle while meeting the same or better performance as in the original design. The new approach was used for developing the load path strategy of a complex system model by decomposing it into structural subsets. Components in the load path were developed primarily through decoupled structural simulations. The method facilitated evaluation of a large number of design choices compatible with other design constraints.

The primary focus of mass reduction was efficiency of load path strategy and exploitation of unique geometrical shapes feasible in a motor compartment rail hydroforming process using new optimization techniques (HEEDS). In addition, the components were made insensitive to prescribed variations to insure robust system level performance. A subset of the new optimized design was incorporated into the ODB test vehicle for verifications. The test vehicle (original architecture and new hydroformed motor compartment structure) had comparable performance though the mass of new vehicle load carrying members was 20% less.

Keywords

LS-DYNA, optimization, decoupling, decomposition, crash, safety, automotive, structure, hydro-forming