SIMPLIFIED HEAD IMPACT MODELING ONTO ENERGY ABSORBING ALUMINUM AND HONEYCOMB STRUCTURES

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ABSTRACT

During recent years auto and aircraft manufacturers have shown an increased concern over passenger safety. Research conducted by several institutions demonstrated that severe fatalities could occur when a seated occupant's head collides with instrument panel, bulkhead, interior walls, and front seat. Automakers overcame this problem by installing airbags for the front seat occupants. Use of airbags in aircraft has been shown to be a difficult task, but energy absorbing mechanisms could be used as an alternative to airbags. This thesis outlines different types of testing from a complex fun scale sled test to a component test like a simple ball drop test that can be used to evaluate head injuries. Component testing is easy to perform as it involves with less complicated instrumentation. In recent years, computer simulations are becoming more popular since they could reproduce different crash scenarios within a short period. The computer simulations, however, do not eliminate the need for actual testing, but they provide a very cost efficient means to study the potential human injuries in a crash environment. There are several factors such as the impact velocity, occupant mass, type bulkhead or front panel, seat pitch, and the location of head collision on the panel which control the severity of head injury. This information could in turn be used in the selection of suitable materials for the bulkhead, instrument panel, or interior walls of an aircraft. Parametric studies with aluminum and honeycomb panels were performed using ball drop simulation. Use of thin aluminum or honeycomb as bulkhead constituents could satisfy the crashworthiness requirements of aircraft industry. The developed analysis tool also allows aircraft designers to simulate a variety of crash events in order to obtain information on mechanisms of crash protection, designs of seats and safety features, and biodynamic responses of the occupants as related to possible injuries.