Design, Fabrication and Project Workflow of Low-Cost Impact Attenuator for Formula SAE Car

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ABSTRACT

The automotive industry is constantly investing in research and development of safety devices capable of actively or passively protecting the driver and passengers from crash related injuries. The impact attenuator is a key device of the safety pack items in production and race cars. This component is designed purposefully to absorb the impact energy by progressive plastic deformation, diminishing the deceleration relative to a direct impact. Research and design have advanced in the passive and active safety items to reinforce and secure safety for humans interacting with the vehicle, causing costs for high end carbon fiber or foam impact attenuator to be common in FSAE use globally. But the financial and logistical cost of impact attenuators made of off these materials remains a problem for the majority of FSAE teams in countries like Brazil or India. This paper aims to design and fabricate a cost-effective, lightweight, easy to manufacture FSAE type impact attenuator made of widely available materials (low cost aluminum alloys). The component was simulated using dynamic explicit crash test simulations. The project workflow and optimization relied on a series of factors: comparative study of aluminum alloy crash test performance, plastic and elastic energy absorption, safety factor, front bulkhead deformation, peak deceleration and mass. The experimental drop test was performed in the laboratory. The project requirements used were set accordingly with the 2021 Formula SAE rules. Drop test peak deceleration and energy absorption satisfied the functional capabilities found in the rulebook. Thus, creating a device and project workflow that tackles logistical, performance and cost issues for the majority of Brazilian FSAE teams.

Keywords: Drop Test Analysis, Low Cost Impact attenuator, Formula SAE, Project Workflow, Crash Test Analysis