

Design and simulation of frontal car crash tests. Crash test simulation via PAMcrash®

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Background

In nowadays, the current trends in automotive engineering are low fuel consumption and reduction in greenhouse gas emissions; government regulations are becoming more strict each year. Therefore, weight reduction is becoming a crucial factor in the development process. To do so, the vehicle's behaviour during a crash has to be overlooked and crash test simulation can provide crucial information for this purpose. Furthermore, the ability to simulate such tests with software has a significant impact in development cost reduction, since these tests usually require a major investment. Simulations were carried out with the usage of PAMCrash® software (ESI Group) and the performance of each part during crash testing could be monitored. During this study, standard European simulation parameters were used. Several designs were simulated and their performance was analysed and validated by a small team of engineers at IQS School of Engineering.

Objectives

The main purpose of this projects was to carry out simulations of low speed crash tests with the intention of minimising the frontal damage of the car to be repaired for insurance purposes. Ideally, the crash box and crossbar are screwed to the longitudinal beam and should be replaced after impact without damaging the longitudinal beam nor the radiator. The tests speed was 15[km/h] with two different masses of 1000[kg] and 1500[kg] to predict the car's behaviour in a simulated two different versions. Cost and weight were monitored for each proposal.

Parts and Design:

There are three main parts involved in low speed insurance crash testing on Compact class vehicles: Crossbar, Crashbox and Longitudinal Beam (Fig 2). These parts were designed via SOLIDWORKS to obtain a simplified model. It occurred to be necessary to mesh with less nodes, in order to have a reduced simulation time.

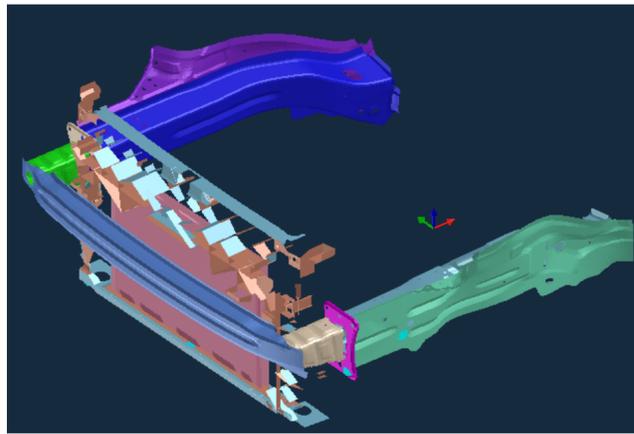


Fig 1: Real model

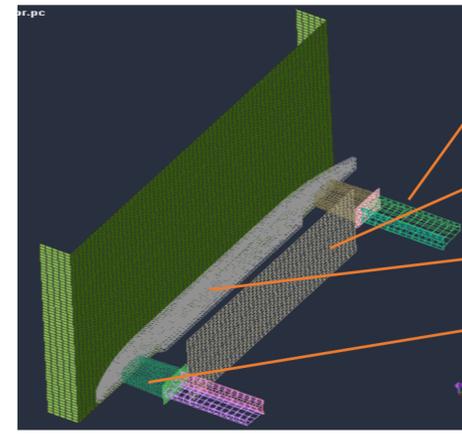


Fig 2: Simplified model

Process and development

The initial intended longitudinal beam developed was not able to handle the crash energy. A first crash simulation was done to analyze its performance, by using welded joints. Then, the same crash simulation was done with two symmetrical longitudinal beams, as shown in Fig 3. Subsequently, the full crash simulation was designed, and the post-processing analysis was prepared to show that such beams should not exceed forces of 197.6[kN] for the longitudinal beam and 134.4[kN] for the crashing box. Simulations were used to optimize this figures and keep them in the safe zone.

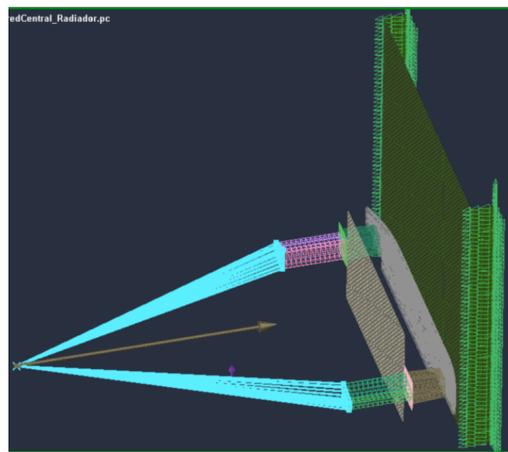


Fig 3: Symmetrical longitudinal beams

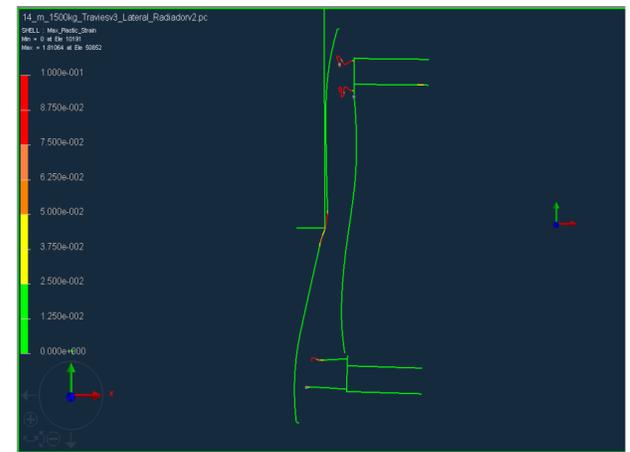


Fig 4: Worst case post-processing Analysis

Results

All the presented crash cases were validated and checked for avoiding longitudinal damage for the beam and radiator.

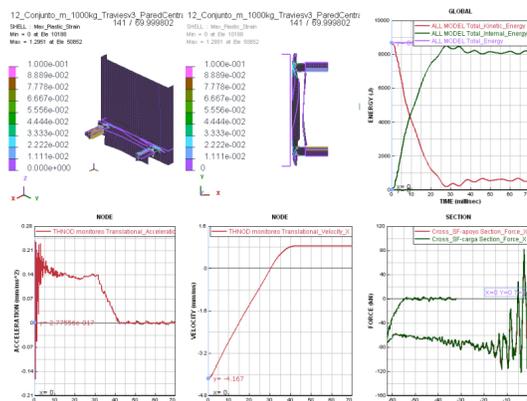


Fig 5: 1000 kg Crash in Center

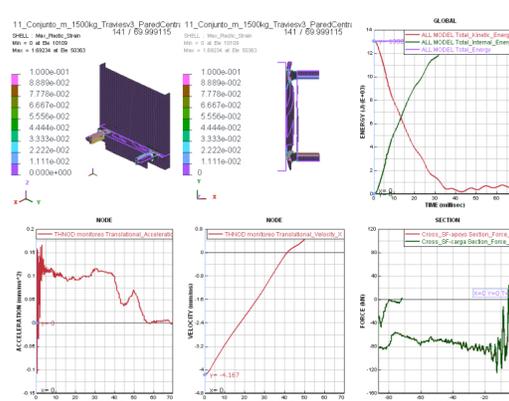


Fig 6: 1500 kg Crash in Center

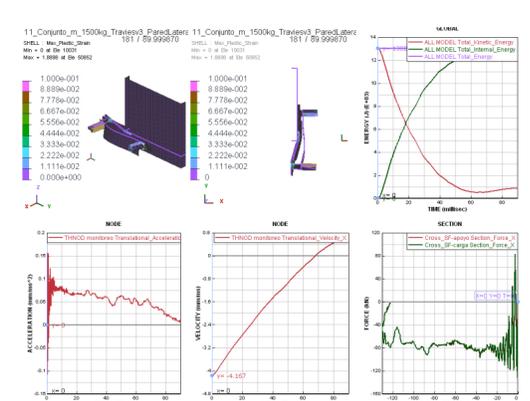


Fig 7: 1500 kg Crash at LB



More information

