Collision of a light weight passenger car against a steel bridge barrier: evaluation of severity indices varying impact conditions

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Summary:

The standards which fixes guidelines for the execution of crash tests to assess the effectiveness of safety barriers in USA and Europe, define an experiment with a low weight passenger car. Such an investigation's aim is to evaluate risks for vehicle's occupants in case of impact against the tested device. The congruence of this approach with the philosophy of testing at "the practical worst condition", has been widely demonstrated in literature. On the other hand, this kind of tests are really expensive and many parameters are hard to control and measure.
Due to the aforementioned reasons, numerical analysis of vehicles collisions against safety barriers has become a convenient methodology that supports and integrates the previous one, especially considering the continuous technological hardware/software progress. Besides, the chance of controlling and evaluating each factor which influences full scale crash tests, makes such a methodology an important tool to perform parametric studies to assess the influence of different factors on crashworthiness.
This research, carried out with a combine numerical experimental approach, is intended to assess what happens during the collision of a light weight passenger car against a steel bridge barrier with a containment energy level of 724kJ.
The work includes three parts. In the first, the fundamental steps of the modelling process are described along with any requirements needed to reproduce four different full scale tests: the frontal and oblique collisions against a concrete wall and the impacts against two types of steel barrier with different containment energy level (127kJ and 724kJ). Data comparison between full-scale and FE simulation concerns time histories of longitudinal and transversal acceleration of CG's vehicle, ASI, THIV, PHD, pitch and roll angle, velocity variation in the vehicle direction and residual displacements of the barrier. The second part is aimed at clarifying what happens during the impact of the light weight passenger car against a steel bridge barrier. The obtained results clearly show that the acceleration of CG's vehicle and the value of impact severity indices are affected in a meaningful manner not only by the transversal kinetic energy but also by the impact angle. The last part defines a simple procedure useful to estimate the impact severity indices for a very wide range of impact conditions. The tests performed on the procedure show a very good agreement between estimated and calculated values.

Keywords:

Light Weight Passenger Car, Steel Bridge Barrier, Impact Condition, ASI, THIV, PHD .

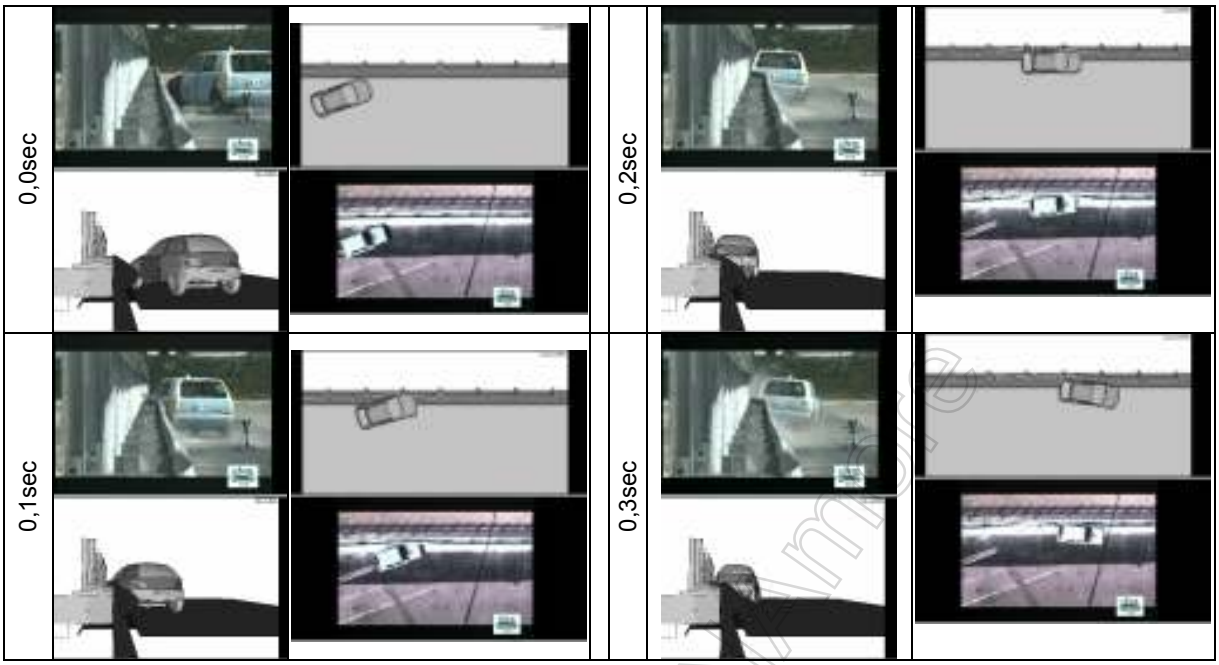

Figure 1: scratch images of the impact (retro and top camera)

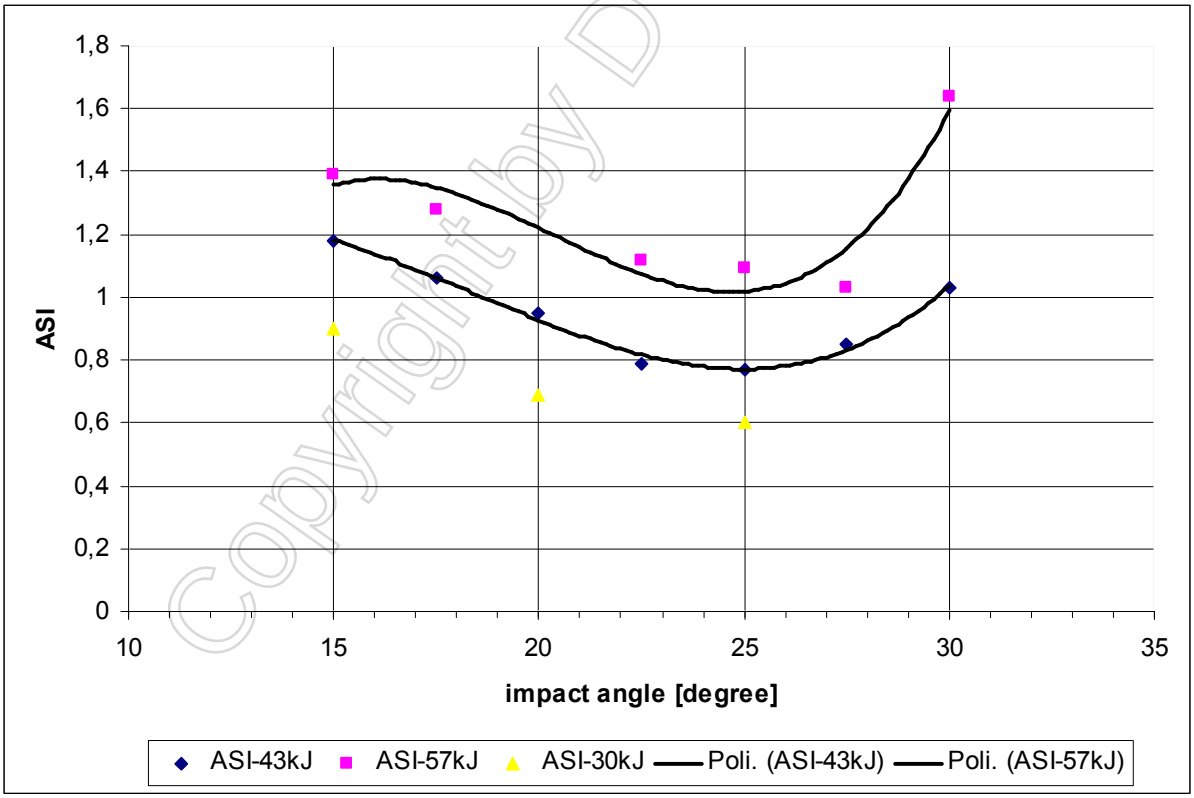

Figure 2: Acceleration Severity Index (ASI) varying impact conditions