Finite element development and early experimental validations for a three dimensional virtual model of a bus

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Summary:

Road safety barriers in Europe have to fulfil the European standard EN 1317, which defines a set of crash tests for each safety barriers containment levels. Full scale tests of vehicle collision against road safety barriers have a huge importance to assess the outcomes of real accidents and, more in general, to identify barriers and vehicles features which influence crashworthiness in a meaningful manner. On the other hand, this kind of tests is 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.
The paper presents finite element (FE) development and the early experimental validations for a three dimensional virtual model of a bus. The main objective of this research activity is to create a simplified FE model of this kind of vehicle useful to simulate collisions against road safety barriers in a wide range of impact conditions. Particular attention was paid in modelling features of the bus such as frame, suspensions and tyres, which influence in a meaningful manner the behaviour of the vehicle during a collision. The bus model complies with the requirements for the homologation of H2-type barrier (test TB51), in accordance with European standard EN1317.
To evaluate the general behaviour of the finite element model of the bus, two different impacts were simulated, (i) against a concrete wall and (ii) against an H2-type barrier. These collisions represent two situations extremely different considering transformation of vehicle kinetic energy. Indeed, concerning the impact against concrete wall, a large part of kinetic energy changes in vehicle internal energy causing a collapse in a wide portion of the bus. Differently, in the case of impact against a steel barrier, vehicle kinetic energy is transformed in device internal energy, but the impact against posts stresses tires, axles and suspensions in a huge manner. Besides, the roll angle is grater than the one registered during the collision against the wall, because the average high above ground of the global action is less than the previous one, causing a larger upsetting moment and a significant stress on the suspensions. Due to previous reasons, the collisions against a concrete wall and against a steel barrier, represent excellent preliminary tests to verify the numerical robustness of the FE model of the bus and to evaluate the general good behavior of the vehicle during collisions in a wide range of impact conditions.

Keywords:

Three-Dimensional Virtual Model of Bus, H2-type Steel Barrier, Concrete Wall, Validation of FE Model

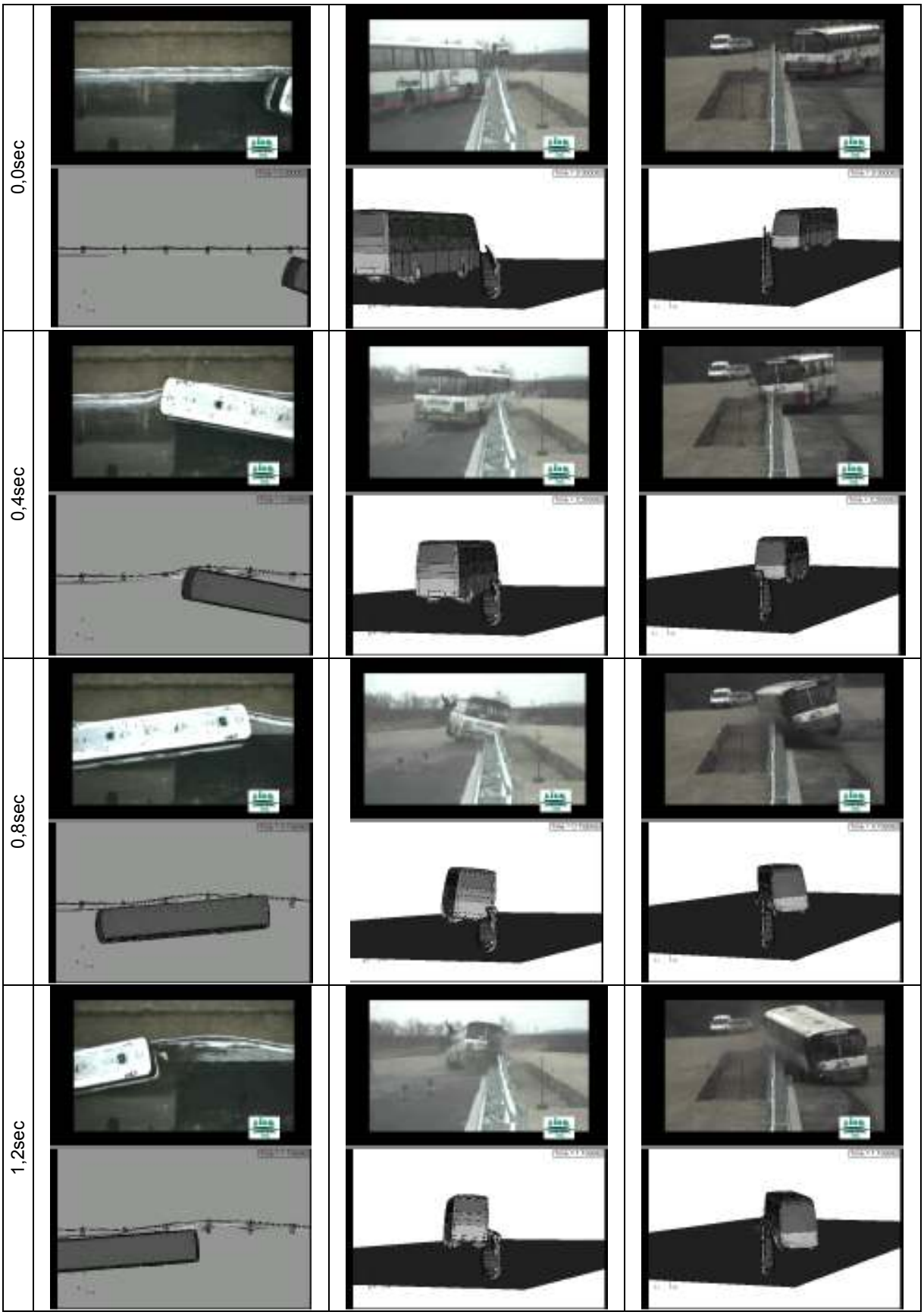

Figure 1: scratch images of the impact of the bus against the H2-type steel barrier