

Numerical Analysis of Double-Impact Test of the 1500-kg Vehicle on the Cable Barrier System

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Abstract. The case where the vehicle strikes road safety barrier and damages it, followed by the secondary impact at the same place belongs to one of the most dangerous which can happen on the roads. The present work shows some numerical results of FEM simulation of such double crash scenario with the cable barrier system.

INTRODUCTION

Every day on roads and motorways, many scenarios of accident may occur in which safety barriers have to minimize their negative consequences. To cover these situations and ensure an adequate level of safety, European standards [1] describing requirements that safety barriers must obey have been established. Nowadays, the continuous development of numerical methods allows for their use to study the properties of safety barriers [3]. Current standards [1, 2] enable using numerical simulations to certify safety barriers under certain conditions, and this possibility raises the possibility of use of numerical simulations in the device certification process. Numerical methods are also applicable to study the cases that are not included in the standards like e.g. impact into already damaged barrier.

Objectives and Methods

The main objective of this study is to derive and to validate numerical model based on the results from full-scale crash test. Afterwards this model was used to conduct the double-impact simulation. The first 1500-kg vehicle struck the barrier at a velocity of 110 km/h at 7 degrees, the second car impact the barrier into the same place and with the same velocity, but the impact angle was set to 20 degrees. **FIGURE 1** presents a comparison of damages arising in the experimental test with the result from simulation. Simulations were conducted using LS-DYNA R8.1.0 code.



FIGURE 1. Comparison of the results obtained from full-scale crash test (left side) and numerical simulation (right side)

RESULTS OF NUMERICAL SIMULATIONS

The course of the car obtained from the numerical simulation is shown in **FIGURE 2**. The results obtained in two impacts are presented in **TABLE 1**, the first impact is shown on the top, the second is displayed below. As a result of the second impact, the working width increases, yet the barrier behaves correctly and fulfills its task of containing the vehicle and remaining its continuity.

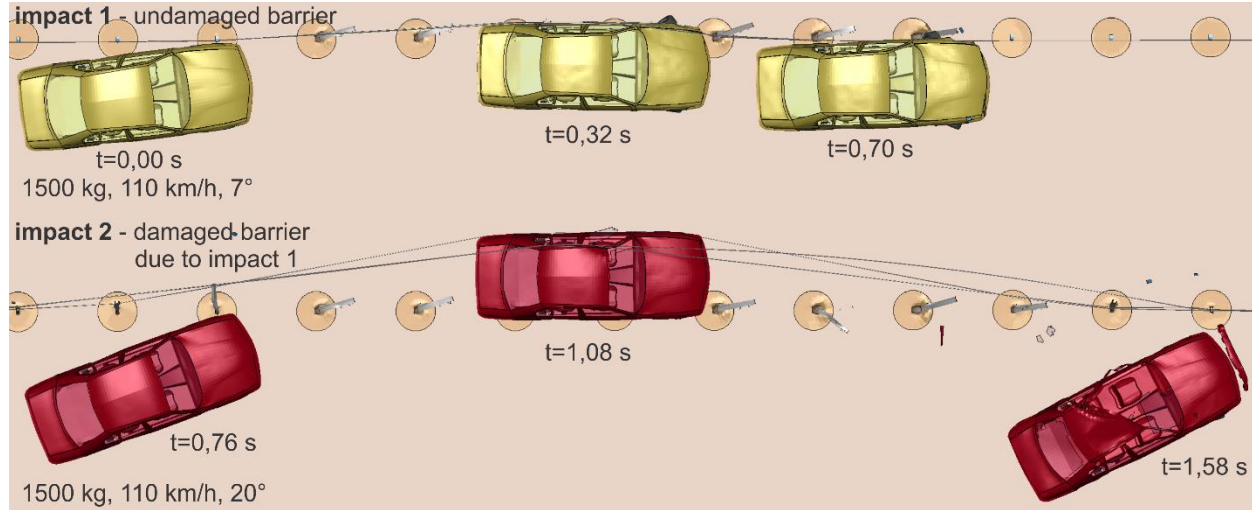


FIGURE 2. The trajectories of the vehicles during crash test (1500 kg, 110 km/h, 7° and 20°)

TABLE 1. Results of the numerical simulations of double-impact test

Impact	Vehicle	Mass kg	Velocity km/h	Angle °	ASI [1] –	THIV [1] km/h	W_N [1] m	Contact length m
No. 1	BMW	1500	110	7	0,38	14,0	0,62	17,4
No. 2				20	0,74	13,2	1,69	18,9

CONCLUSION

The impact of the vehicle into the damaged section of the barrier is particularly dangerous. Indicators (except THIV) obtained as a result of the second impact on the damaged system exceed the values from the standard TB32 test [1] for the undamaged device, however, it should be emphasized that the barrier effectively contained and redirected the vehicles back on its previous trajectory without damage of its principal longitudinal elements.

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