# Numerical simulation of triple TB41 crash test against concrete road safety barrier

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**Abstract.** The work presents brief description of validation process of a model of road concrete barrier. Triple Heavy Goods Vehicle's (HGV) impacts against the barrier are investigated to assess barrier damage. Failure assessment criterion for concrete is presented. Performance parameters for road safety system and impact severity indexes are established.

## INTRODUCTION

Concrete barriers are frequently used as a high containment level [1] road safety systems. They are designed to maintain heavy weight vehicles along the road in the desired direction. According to the European Standards [1], during certification, barriers are subjected to impact of a single vehicle. However, additional impact may occur in the real life. Thus, additional impacts are worth investigating. The obtained numerical results show that the considered barrier can still properly redirect vehicles even after being exposed to three consecutive impacts.

## OBJECTIVES AND METHODS

Firstly, a reliable and detailed numerical model of concrete road safety barrier have been derived. Good qualitative and quantitative correlation has been obtained and compared with the standard's requirements [2]. Visual comparison is displayed in **FIGURE 1**. Then, additional simulations have been conducted for the barrier subjected to the consecutive impacts. Simulations were performed using explicit finite element code LS-DYNA [3,4].

**FIGURE 1.** Comparison of the results obtained from the full-scale crash test and the numerical simulation

## RESULTS OF NUMERICAL SIMULATIONS

Damage of material for each consecutive impact is shown in **FIGURE 2**. Finite elements that have reached certain effective plastic strain value are marked using greyscale. The black color represents the highest values of maximum of brittle and ductile damage. The resultant performance parameters and severity indexes are presented in **TABLE 1**. As may be seen each consecutive impact results in larger working width and more severe damage done to the barrier.

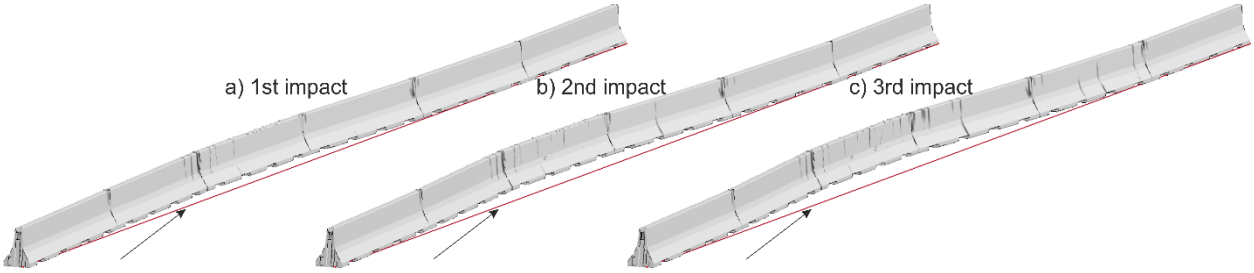


**FIGURE 2.** Overview of concrete damages for each consecutive vehicle impact

**TABLE 1.** Results of numerical simulations of triple-impact crash test

| **Impact** | **Vehicle** | **Mass** | **Velocity** | **Angle** | **ASI** [1] | **THIV** [1] | $\mathbf{W}_N$ [1] |
|---|---|---|---|---|---|---|---|
| | | kg | km/h | ° | – | km/h | m |
| No. 1 | | | | | 0,30 | 4,0 | 0,94 |
| No. 2 | HGV | 10000 | 70 | 7 | 0,43 | 11,7 | 1,1 |
| No. 3 | | | | | 0,41 | 11,1 | 1.22 |

## CONCLUSION

After successful validation of the concrete barrier numerical model, the additional parametric analysis has been performed. Basic barrier's performance parameters have been shown with corresponding effective plastic strains plots. Taking into consideration presented results following conclusions may be drawn. For three consecutive impacts initial barrier deformation slightly affects impact severity indexes. Impacts on initially deformed barrier results in larger value of working width and wider area of damaged material. However, according to this numerical simulation results, barrier is still properly redirects the vehicle.

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