Testing the Influence of the Stiffness of Construction Elements of a Military Vehicle on the Safety of the Crew

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Abstract. The selected variants of strengthening the construction of a military vehicle subjected to the effects of the wave of pressure coming from an explosion have been analysed in the article. The paper includes the validation process of a numerical model based on the results of experimental tests of a real object, carried out on the testing ground. As a result of the conducted numerical analyses, the characteristics of the selected impact factors in the explosive wave-vehicle-dummy scheme have been presented. In order to assess the influence of strengthening the construction, the selected biomechanical factors, such as the acceleration of the dummy's head, and mechanical factors, such as the acceleration of the vehicle's wall, have been chosen.

INTRODUCTION

Nowadays, designing and building modern military vehicles is quite a challenge for military engineers [2]. Ensuring appropriate parameters of the construction before it is equipped with additional protective systems, e.g. external panels, constitutes the basis in designing a new construction [1]. The first stage of designing focuses on the plating which is the foundation for introducing internal frames which provide the stiffness of the entire construction. Taking into consideration the overall assembly of the vehicle's protective systems, frames are just one of its elements, however, their appropriate design might have a significant influence on the provided level of protection of the crew [5].

MATERIAL AND METHODS

The geometrical model of the vehicle's body provided by AMZ Kutno has been used in the numerical analyses. Discretisation has been conducted using the Hypermesh programme, whereas pre- and post-processing has been carried out using the LS-Dyna and LS-Prepost software [3]. Initially boundary conditions corresponding to the experimental tests, which have been conducted using the real model of the body of the vehicle with a weight close to 7 tonnes, have been assumed in the numerical modelling. Factors such as the place of detonation and the mass of the explosive as well as the variant of the construction subjected to the effects of the wave of pressure have been taken into consideration during the numerical analyses. The body of a light wheeled armoured vehicle with a passenger cabin has been used as the vehicle's model in the tests. The EuroSID-2re dummy has been placed in the vehicle and accelerometers measuring the acceleration of the side wall have been installed [4].

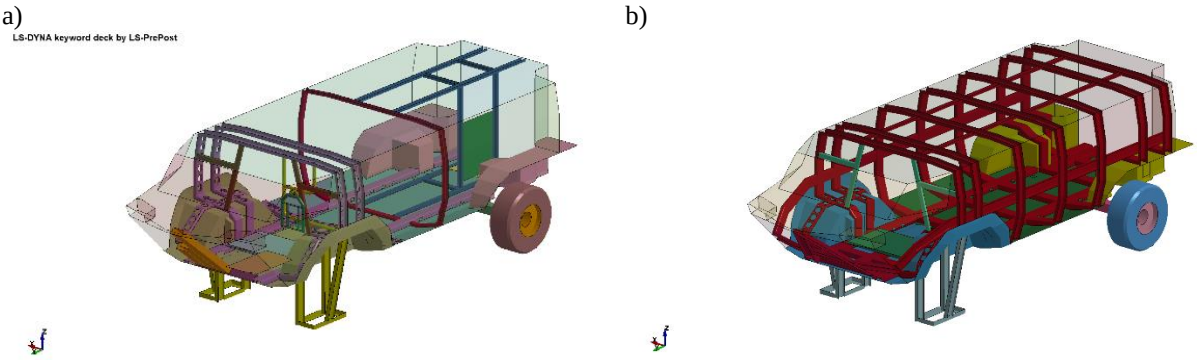

FIG. 1. The view of the geometry of the numerical model in half-section a) the referential model, b) the model with a modified frame structure

The Conwep algorithm implemented in the LS-Dyna system has been used in the simulations of the explosion of a TNT load. The analyses have been carried out for the variable mass of the explosive in the range from 1 to 10 kg.

RESULTS AND CONLUSIONS

The results obtained on the basis of the numerical and experimental tests have rendered it possible to state the correct description of real phenomena through the numerical analyses and thus the correct performance of the validation process. Comparative analyses of the vehicle's construction enable determining the influence of different design solutions on the effects of the shock wave on the vehicle and of the vehicle on the occupant. The use of additional frames has decreased deformations of the vehicle's plating and thus had a positive influence on the nature of biomechanical factors which show lower probability of the occurrence of specific types of injuries.

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