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AN ANALYSIS OF POSSIBLE USE OF BENCH TESTING IN SPECIAL VEHICLE'S SEATS VERIFICATIONS

Maciej DORCZUK*, Robert SOSNOWICZ*

* *Department of Tracked Vehicles, Military Institute of Armor and Vehicle Technology*
email: maciej.dorczuk@witpis.eu
email: robert.sosnowicz@witpis.eu

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Abstract:

The following paper presents a capability analysis of the development of an inventive research method for testing seats of military vehicles at the laboratory station without use of explosives. The proposed method takes under consideration the use of data from tests, when the explosive charges were used, and reproduce the overloads that accompany the phenomenon of explosion at the laboratory station.

Keywords:

drop test, crew safety, explosion under the vehicle

INTRODUCTION

The measurements of overload values, duration and pulse transition times occurring on the lower and upper plates of a wheeled vehicle hull of the gross mass approximately 20 metric tonnes, were conducted in order to evaluate the possibilities to use of these data in method development of military special vehicles' seats testing. A constructed methodology will be used in researches on explosion phenomenon and associated overload, without the use of explosive charges at the laboratory station.

Measurements collected during two explosive charges detonations served the purpose of randomness elimination and confirmation of the test repeatability.

The implemented method will be innovative on national level. Similar methods are used by the Western companies, operating outside of our country's borders, and

which specialize in production of special seats that increase security of military vehicles crews.

1. RESEARCH MAIN GOAL AND METHOD

The main goal of field tests with the use of explosive charges was to estimate the overload values occurring on the hull's lower an upper plates of a military vehicle, as well as duration and pulse transition times. The registered and analyzed time signals from two tests allow a determination of occurring overload, pulse duration and rise times differences between hull's lower and upper plates.

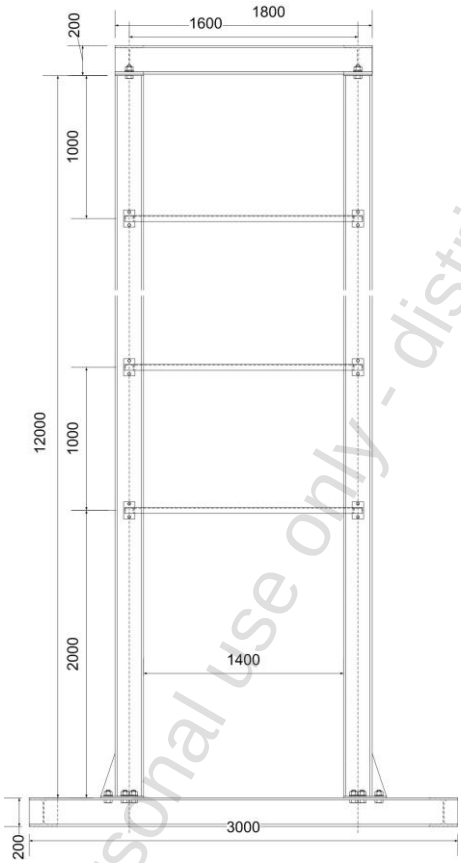

Fig. 1. Draw of station for "drop test" (main dimensions)

Source: Own elaboration

Obtained results and conclusions were indispensable to start works on the development of laboratory research methods on the prepared "drop test" station at the Military Institute of Armor and Vehicle Technology (Fig.1). This publication constitutes one of the phases of execution of the statutory task "*Development of military vehicle seats testing methodology aimed at enhancing crew survivability in cases of TNT or IED detonations, including a development of method and building the station for experimental testing of seats that increase physical protection of vehicle crew.*"

On the grounds of lack of information regarding measured values, various acceleration sensors were implemented during the test, mainly in the measured range, two sensors were placed on each plates – lower an upper.

The measurement track equipment (Fig.2) employed to measure occurring overloads on the hull's lower and upper plates consists of the following:

- Sampling frequency recorder of 500 kHz per channel;
- Conditioner with four channels used (two channels were used for amplification and adjustment of signal from sensors mounted on upper plate; remaining two channels were used for amplification and adjustment of signal from sensors mounted on the hull's lower plate) (Fig.3);
- Triset coaxial cables.

Sensors:

- One acceleration sensor of the measurement range of 100 000 g;
- Two acceleration sensors of the measurement range of 50 000 g;
- One acceleration sensor of the measurement range of 10 000 g.

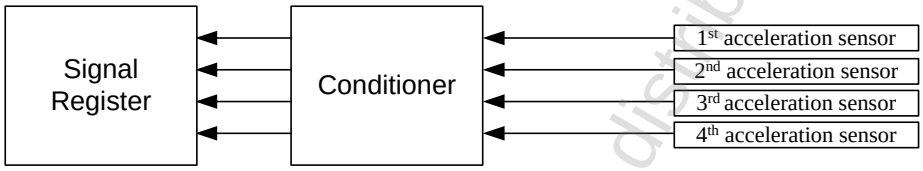

Fig. 2. Measurement track

Source: Own elaboration

The sensors were placed inside of the vehicle on the upper and lower plates in one line approx. 115 cm, during detonation of explosive charges under the first wheel, and during the second test – approx. 80 cm, which is presented in the Fig.3.

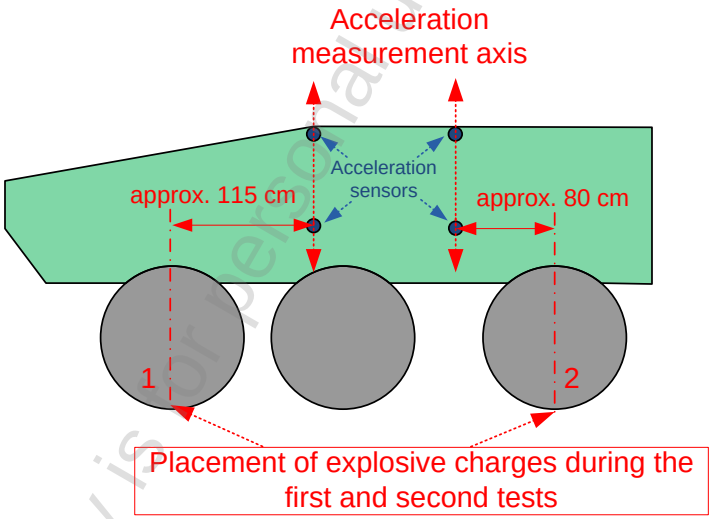

Fig. 3. Vibration transducers mounted on the upper and lower hull's plate during first test (detonation of explosive charge under first left wheel) and second test (detonation of explosive charge under third left wheel)

Source: Own elaboration

2. AN ANALYSIS OF THE FIELD EXPERIMENTS RESULTS

Based on the results of conducted analysis presented in Fig. 4 ÷ 9, it can be stated that they could be used for future phases of research methods development on the "drop test" station, in the process of simulations of explosion phenomenon and acceleration affecting crew members. Constructed "drop test" station and conducted in the future laboratory tests reproduce the conditions existing during detonation of explosive charges under a military vehicle.

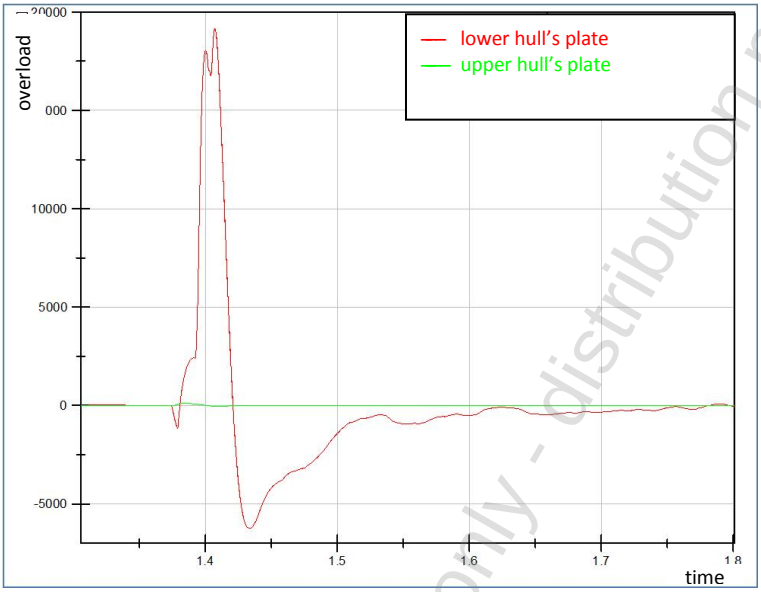

Fig. 4. Comparison of registered overload values during the first test on the hull's lower and upper plates during detonation of explosive charge.

Source: Own elaboration

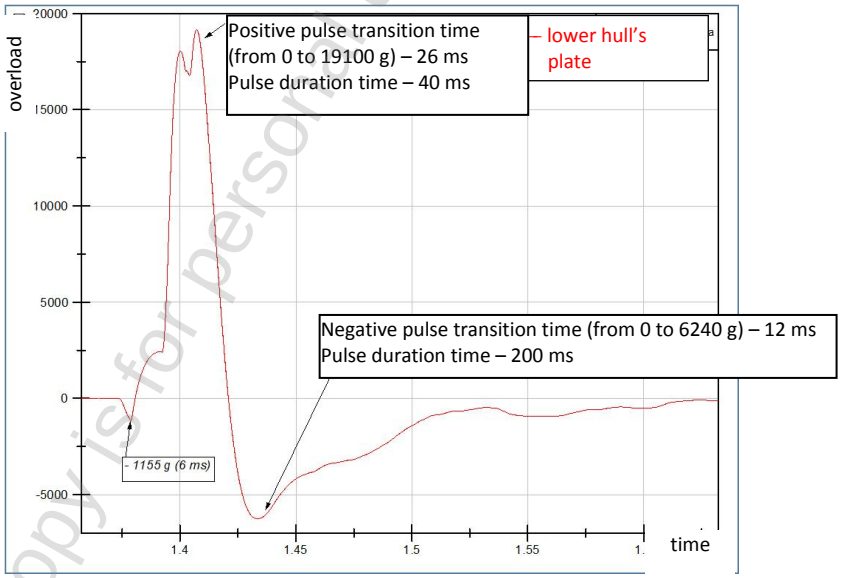

Fig. 5. Registered overload values during the first test on the hull's lower plate during detonation of explosive charge

Source: Own elaboration

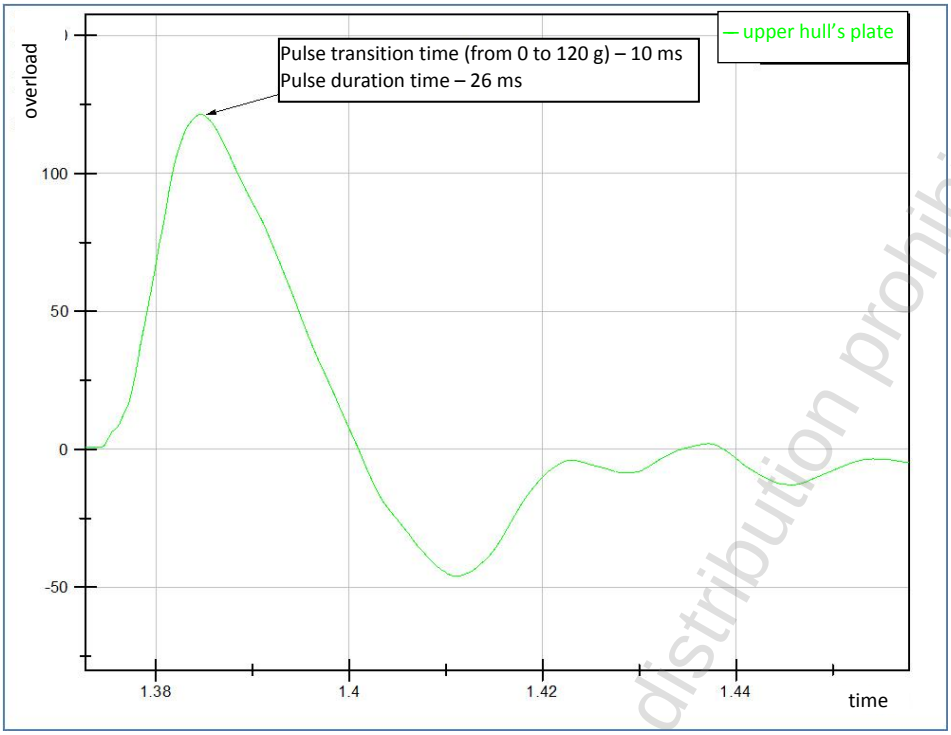

Fig. 6. Registered overload values during the first test on the hull's upper plate during detonation of explosive charge

Source: Own elaboration

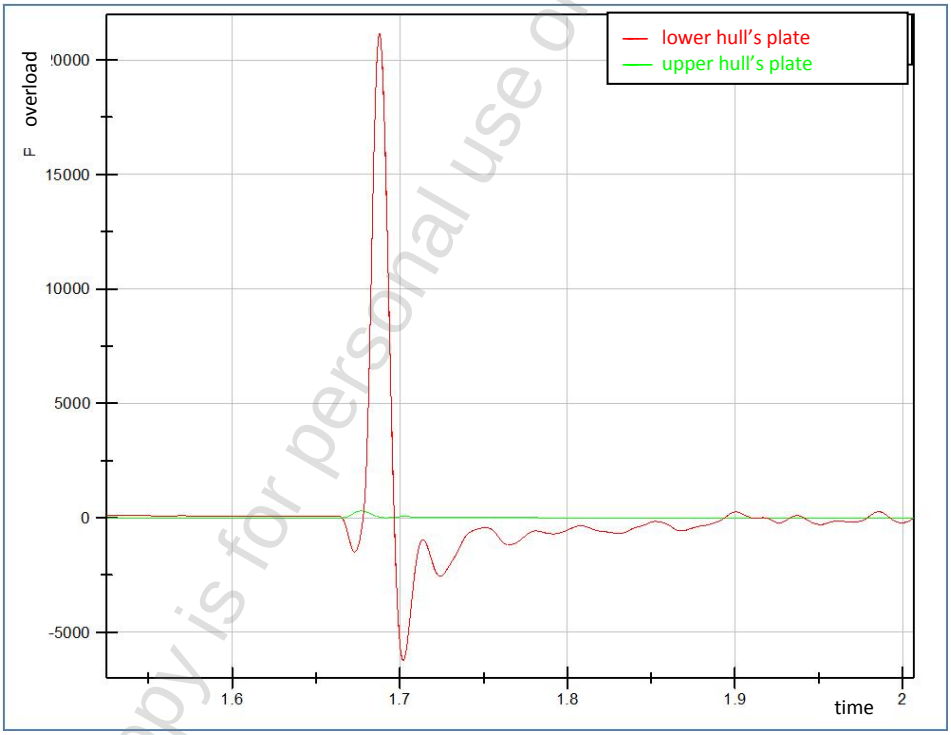

Fig. 7. Comparison of registered overload values during the second test on the hull's lower and upper plates during detonation of explosive charge

Source: Own elaboration

Fig. 8. Registered overload values during the second test on the hull's lower plate during detonation of explosive charge

Source: Own elaboration

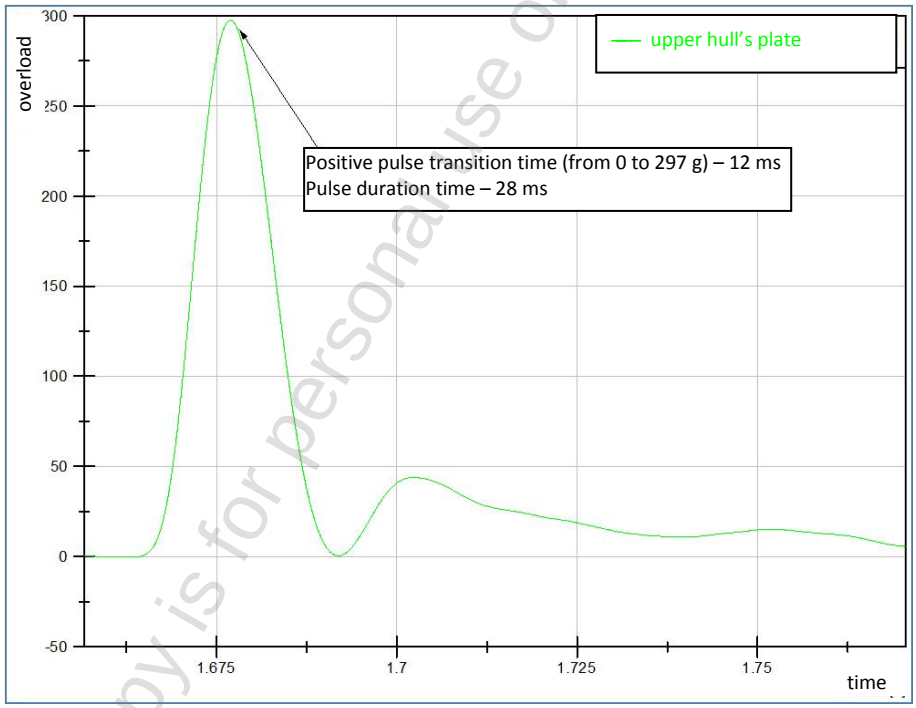

Fig. 9. Registered overload values during the second test on the hull's upper plate during detonation of explosive charge

Source: Own elaboration

CONCLUSION

According to some military experts opinions, in the course of the following years, among ground vehicles the most demanded will be light armor vehicles equipped with various systems increasing security [1].

According to military experts from various countries, modern special vehicles should have many features. One of these is capability to mount extra equipment, including special seats increasing safety and comfort at the same time. Therefore, in the search of innovative solutions in seats increasing safety, it is important to verify them.

Before starting tests and evaluation of special seats, the work presented in this article was conducted and aimed at measuring of overload values, duration and pulse transition times occurring on a wheeled vehicle hull's lower and upper plates, as well as an analysis of obtained results in order to estimate the possibility to transfer the phenomenon to the "drop test" laboratory station.

The main conclusion was formulated in the following way: *"Based on the conducted field tests and the results analysis, it can be stated that they constitute substantial factual value for development of innovative test methodology to research explosion phenomenon with regard to increasing crew members safety, and able to conduct tests at the "drop test" station at the Military Institute of Armor and Vehicle Technology, as well as verification of solution parameters implemented in special seats."*

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BIOGRAPHICAL NOTES

Robert SOSNOWICZ, LTC, DSc, - an engineer, director of the Department of Tracked Vehicles of the Military Institute of Armor and Vehicle Technology in Sulejowek. His main area of interest include research and development of fast tracked vehicles used in combat operations. A director and member of various researches on tracked vehicles designed for military operations, as well as their special equipment. The author and co-author of publications on vehicle research, development and operations.

Maciej DORCZUK, MAJ, MSc, - mechatronics engineer, director of laboratory in Department of Tracked Vehicles of the Military Institute of Armor and Vehicle Technology in Sulejowek. His main area of interest includes an estimation of parameters of unmanned and manned onboard weapon stations. A member of teams researching military weapons and equipment. Number of publications – 6. Prizes: Diploma of WITU Director awarded during 18th International Science and Technology Conference "Weapons" in 2011 in Pultusk, Poland.

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