DESIGN OF FLATBED FOR CARRYING DAMAGED AFV ROSOMAK BY AIR TRANSPORTATION

Grzegorz Motrycz, Piotr Stryjek

Military Institute of Armored and Automotive Technology
1 Okuniewska Street, 05-070 Sulejówek, Poland
tel.+48 22 6811012, fax: +48 22 6811073
e-mail: grzegorz.motrycz@witpis.eu, p.stryjek@wp.pl

Henryk Kałwa

Proxy Office of the Minister of National Defense
for Wheeled Armored Fighting Vehicle
1 Okuniewska Street, 05-070 Sulejówek, Poland
tel. 606173819
e-mail: kalwah@tlen.pl

Abstract

IED (Improvised Explosive Device) – those special type of mines have occurred in the last decade with particular intensity in the recent Afghan conflict. Due to their structure and the use of large weights of explosives, the improvised explosive devices pose very high risk on any wheeled AFVs. There is a need to have some logistic solution, to security transport of damaged AFV. Polish army needs a new semi- trailer, which would be able to transport damaged AFV on it, from Afghan to Poland, by special cargo airplane, call "Rusłan". Although this paper does not cover mounting of the loaded flatbed to the deck of the aircraft, this subsection analyzes the way how the crew of AN 124-100 aircraft fixes the AFVs during the flight. This study is the result of the research and development project No.O R00 0085 12 „Ancillary flatbed for loading of damaged AFVs ROSOMAK on board of the plane." This paper presents the results from execution of the conceptual works related to the ancillary flatbed construction concept. The construction of technology demonstrator commences on the basis of a scientific and industrial consortium (Military Institute of Armour and Automotive Technology-Air Force Institute of Technology -CELTECH-HYDROMEGA).

Keywords: *operational transportation, AFV Rosomak, IED*

1. Introduction

Since immemorial times, and since the explosives were invented, people have used them primarily for the destroying purposes in the form of bombs, artillery shells and mines. And it is the mines that pose the greatest threat to all vehicles including armored vehicles.

The best known are as follows:

– Anti-tank (armor-piercing) mines;
– Landmines (defensive and offensive) mines;
– Trap mines (most often in the form of gadgets)

IED (Improvised Explosive Device) – those special type of mines have occurred in the last decade with particular intensity in the recent Afghan conflict.

Following the Russian – Afghan conflict (the fraternal assistance of the Soviet Union in Afghanistan), there are a lot of remaining explosives in Afghanistan in the form of mines, bombs, artillery shells, and various ammunition.

Easy access to those war remains has given the opportunity to use them in the form of mine – traps of high total weight of the explosives – the so-called IEDs. Moreover, firepower of such explosives is enhanced by additional shrapnel of hard artillery shells, bombs, grenades, etc. which are part of the improvised explosive device.

Destruction caused by IED explosion with "hard shrapnel" are incomparably greater than in case of the explosion of the same weight of explosive in a thin shell.

Due to their structure and the use of large weights of explosives, the improvised explosive devices pose very high risk on any wheeled AFVs. Used in previous armed conflicts, the mines generally contain 8 to 10 kg of explosives. Such mines were sufficient for the temporary kill potential (usually a halt) of tanks, infantry fighting vehicles and armored personnel vehicles. Most of the time they caused minor damages to running gears, power transmission systems, and braking systems to the extent that allowed for the recovery of their technical efficiency in a relatively short time.

The wheeled armored fighting vehicles that are on a mission in Afghanistan are vulnerable to attacks by guerrilla using machine guns, mortars, antitank grenade launchers, and various types of trap mines. For various reasons, the "guerillas" are fond of attacking the AFV Rosomak using the trap mines in the form of IED (improvised explosive devices). Used for combating AFV Rosomak in the initial period of their use in Afghanistan, the standard anti-tank mines caused significant damage to the running gear, but did not eliminate vehicles irretrievably. After minor repairs they usually returned to their battle formation. The explosion energy of such quantity of explosives is huge and causes a destruction of the vehicle that is difficult to describe. It is even difficult to compare destructive effects of the standard mine that contains 8 kg of TNT with the IED mine containing over 120 kg of TNT, and such IEDs have been identified. Damages incurred by such large bombs are also very large, but the destruction is not proportional to the size of the explosive. The larger the explosive the more explosion energy is dissipated. With so large explosives, one may talk not only about damages but above all of considerable size destruction made to the entire vehicle.

2. Description of Damages Occurring in Armored Fighting Vehicles

Damages resulting from the explosion under the AFV Rosomak first of all depend on:

- explosion energy – that is the size (weight) and structure of the mine;
- place (in the geometric sense);
- bedding structure (sand, asphalt, rocky ground).

The destructive energy of an explosion largely depends on the quantity and type of explosive material as the latter has a decisive influence on the size, type and nature of the occurring damages. This relation as a physical phenomenon is easy to understand, however, the introduction of the relation as described by a mathematical model is virtually impossible.

In our analysis, we are not looking for any mathematical model but for such information that will be useful in practical assessments and applications for the future.

In order to understand the problem how complex the damages resulting from the IED explosion impact on the AFV Rosomak are, I shall present it in (Fig. 1) using various sizes of IED.

Fig. 1. Example of a typical damage in AFV Rosomak

3. Analysis of armored fighting vehicle mounting on road trailers

Transportation of AFV ROSOMAK by sea, land, and air means transport on the flatbed of another vehicle, by train, ferry, or an aircraft. The vehicle must always be transported in accordance with the applicable general provisions.

Preparation of the vehicle for transport means to reduce it to the transportation height using hydraulic and gas shock absorbers pursuant to Clause 3.8.8 „Height adjustment system maintenance" of the maintenance manual and if needed to reduce tires pressure by using CPK system.

If AFV 8x8 in its combat version is carried by international railway transport, then the pressure in the tires should absolutely be lowered down to the „emergency" value or down to zero when carrying the vehicle on 1300 mm high or lower flatbed. The reduced tire pressure in wheels down to zero value is more favorable because the vehicle settles down on the inserts as integrated into the hoops and becomes more stable.

In order to properly determine the method for fixing the vehicle to the flatbed, it is necessary to correctly identify possible mounting points to attached the vehicle. The basic mounting points in AFV Rosomak during transport are shackles in the front and rear parts (Fig. 2, 3a, 3b).

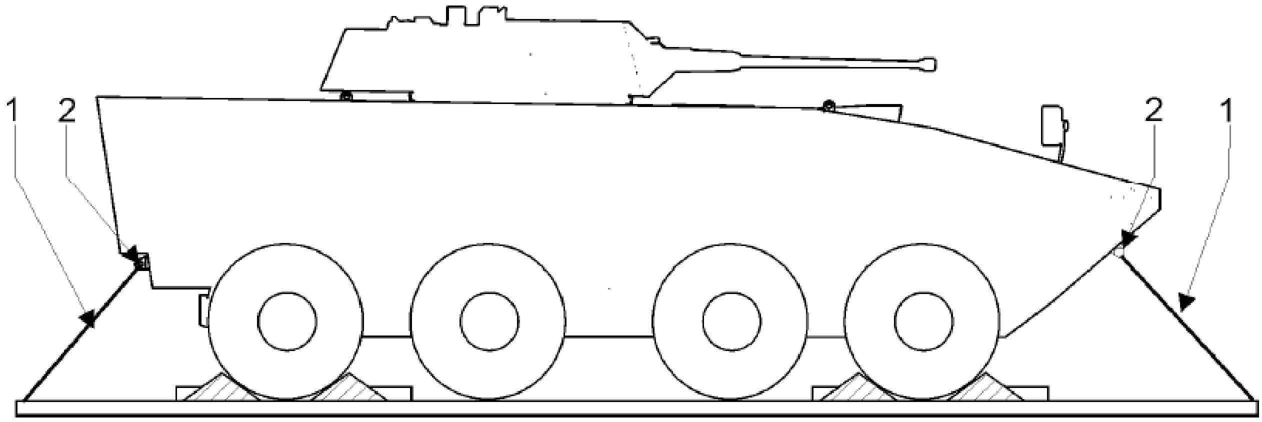

Fig. 2. Example of AFV ROSOMAK mounting on the cargo flatbed (source WZM S.A)

Fig. 3a) View of front mounting points for AFV Rosomak on board of aircraft AN 124-100 (source WITPIS)

Fig. 3b) Example of mounting the damaged AFV transported on trailer by aircraft AN 124-100 (source WITPIS)

According to the results obtained from the research studies conducted at the Institute, the vehicle mounting for the two front and two rear main points is sufficient for road traffic. One should remember, however, about a proper selection of belts and chains because of the breaking force value.

Although this paper does not cover mounting of the loaded flatbed to the deck of the aircraft, this subsection analyzes the way how the crew of AN 124-100 aircaft fixes the AFVs during the flight (Fig. 3a, Fig. 3b).

As already has been mentioned and due to spatial structure of the deck, the mounting force is spread over several chains in many places and that aims to spread the stress into a larger number of load-bearing floor points (cargo area) Fig. 3a.

The above pictures show that the vehicle is also mounted by its suspension components such as wishbones. It is important as hydro-pneumatic suspension has been used in AFV Rosomak type of the vehicle. Bearing in mind that the transported vehicle is damaged, a slow gas leak cannot be excluded from the shock absorbers and thus settling down of the vehicle. This may effect in a situation when chains tension is eased and the vehicle is likely to move on the aircraft deck within the "clearance" of the chains. This is a very serious situation because the chains will be affected by shock forces of inertia during the pull backs of the vehicle. This may lead to a rupture of anchors and a loss of stability of the fasteners mounting the AFV.

Therefore, while construction of the new flatbed it was assumed that the strap system, consisting of two straps at the front of the vehicle and two straps in the rear of the vehicle, will be the primary mounting component. The straps should be fastened "crosswise", which shall make the straps carry both the forces acting along the axis of symmetry of the flatbed as well as the lateral forces.

Thrust wedges should be placed under the wheels of AFV in quantity of 4 pieces per each side of the vehicle. In order to make anchorage independent from elastic components of the suspension, one wheel on each side of the vehicle has been selected to be also mounted directly to the deck of the flatbed.

4. Analysis of loading capacity to a particular type of aircraft

The following tactical and technical parameters of transportation aircraft have been analyzed and nowadays they can be used by Polish Armed Forces for airborne transportation:

- dimensions and volume of cargo bay;
- dimensions and geometry of the loading ramp;
- cargo weight;
- range with a maximum load;
- allowable unit pressures;
- extent of gravity loads occurring during flight in the cargo compartment;
- pressure in the cargo compartment during flight;
- loading capacity.

The basic characteristics of the above-mentioned transportation aircraft are presented in the table below:

Type of Aircraft / **Parameters**	**C-130E**	**C-17**	**CASA-295**	**AN-124-100**
Length of Cargo Bay [m]	12,31/16,90 + 3.12[*1]	20.62	12.69	36.47
Width [m]	2.89	5.18	2.70	6.40
Height [m]	2.74	3.6	1.87	4.40

Type of Aircraft / Parameters	C-130E	C-17	CASA-295	AN-124-100
Cab loading capacity [m³]	161/200	592	57	1013
Load weight [t] (max)	19.0/20.0	76.7	9.7	120.0
Flying Velocity [km/h]	555	796	430	825
Range [km] with maximum load	3704	4440	2300	4500
Number of people	92/128 soldiers or 64/92 parachuters or 74 injured	202 soldiers or 102 parachuters + 4 all-terrain vehicles	72 soldiers or 49 parachuters or 24 injured	88 soldiers in assault version
Qantity of Equipment	6/8x air pallet or 3/4x „Honker”, or 2x BRDM, or 2x Star*2 or 1/2x kont 20’	18x air pallet or 8x „Honker” or 6x BRDM, or 3x Star, or 3x cont 20’	5x air pallet or 2x „Honker“ (dismantled roof)	14x „Honker”, or 12x BRDM, or 10x Star, or 10x cont 20

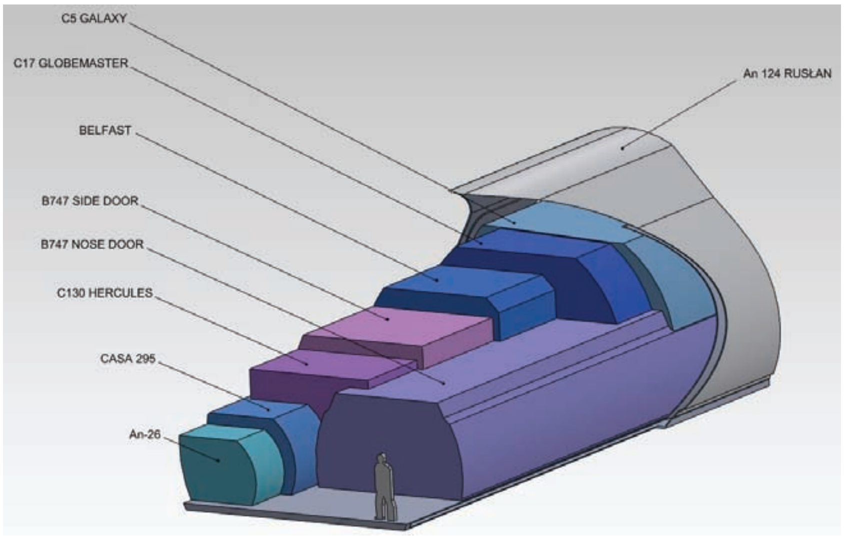

Fig. 4. The loading space in individual types of aircraft, compared with AN 124-100 (source WITPIS)

Based on the analysis performed, it was found that that project technical requirements are met by aircraft An-124 100 (Fig. 4).

5. Summary

On the basis of the analysis conducted, it was fund that the flatbed would have a structure with adjustable height of the skid plate (ranging between 1.20 and up to 1.65 m). It will be assigned for transportation of diverse equipment and cargo weighing up to 27 tons.

Depending on what type of skid plate a given tractor has, the flatbed may have a replaceable bolt with a diameter of 3.5 "(89 mm), or 2" (50.8 mm).

The specialized and exploitational equipment that includes devices, instruments and a set of tools, as well as spare parts should allow for proper operation of the articulated vehicle.

References

[1] Motrycz , G., Stryjek, P., *Influence of the Wheeled AFV (AFV) Structural Design Changes on the Lateral Dynamic Stability of the Motion* – Scientific Papers of gen. Tadeusz Kościuszko Military Academy of Land Forces 1/159, pp.: 192-203, 2011.
[2] Motrycz, G., Stryjek, P. Kałwa, H. (+ team), Report on Task 1 Implementation, *Development of Ancillary Flatbed to Load Damaged AFV ROSOMAK on board of the aircraft*, Military Institute of Armored and Automotive Technology – the unpublished paper, 2011.
[3] *The doctrine of transport and traffic troops Armed Forces*, DD/4.4
[4] *Manual on Deployment of Troops and Armaments and Military Equipment* by Air Transport, DD/4.4.2 (A).