ANALYSIS OF BAR AND NET SCREENS STRUCTURE PROTECTING VEHICLES AGAINST ANTI-TANK GRENADES FIRED FROM RPG-7

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Abstract

The bar or net screens are ones of the methods to increase protection level of military vehicle crews against anti-tank grenades fired from RPG-7. Their task is to prevent generation of the shaped charge jet. The probability of vehicle's protection level when applying such types of screens depends on their structure - percentage share of the open space, i.e. space for which the flying grenade will not touch the structure element with its fuse, but it will be destructed. The two mechanisms are here mainly used: short circuit in the fuse circuit, deformation of conical section of the shaped charge warhead.

This article presents analysis of structure of the bar and net screens due to share of the open space, for various impact angle of grenade in elevation and azimuth. The following were changed: thickness and width of bars and distance between them, thickness of wire and shape of individual net mesh. The solution of bar screen with the lowest weight and grenade destruction ability was selected. This solution was compared with the net screen offered currently on the market For the selected solutions, for angles increasing in elevation, up to 30^0 value, the bar screen has the larger open space than net screen. For angles in azimuth, the bar screen has larger open space for the entire range of angles. The bar screen is heavier by 50-60% when compared to the selected net screens, but their operation costs are lower. They are repaired in field conditions

Keywords: *bar armour, net armour, RPG vehicle protection, active protection systems, military vehicle*

1. Introduction

The methods improving level of protection of military vehicle crews against grenades fired from RPG-7 include: active protection systems, destroying grenades in some distance from the vehicle, various types of reactive armours (ERA, SLERA, NERA, NxRA), reducing the penetration depth, composite armours, reducing penetration depth and angle of dispersion of secondary fragments and additional bar or net screens, destroying grenades in short distance from the vehicle's hull (Fig. 1) [1, 2, 3].

Fig. 1. Type of the applied net and bar screens

The additional screens, surrounding the vehicle in 250÷500mm, shall disturb optimum conditions due to the correct shaping of the shaped charge jet. The two mechanisms are mainly used:

- short circuit in the fuse circuit,
- deformation of conical section of the shaped charge warhead [4].

These mechanisms apply only when the grenade's fuse will not touch any element of the screen structure, i.e. grenade will fly between bars or net wires. At the same time, distance between adjacent bars or net wires must be smaller than the grenade (Fig. 2).

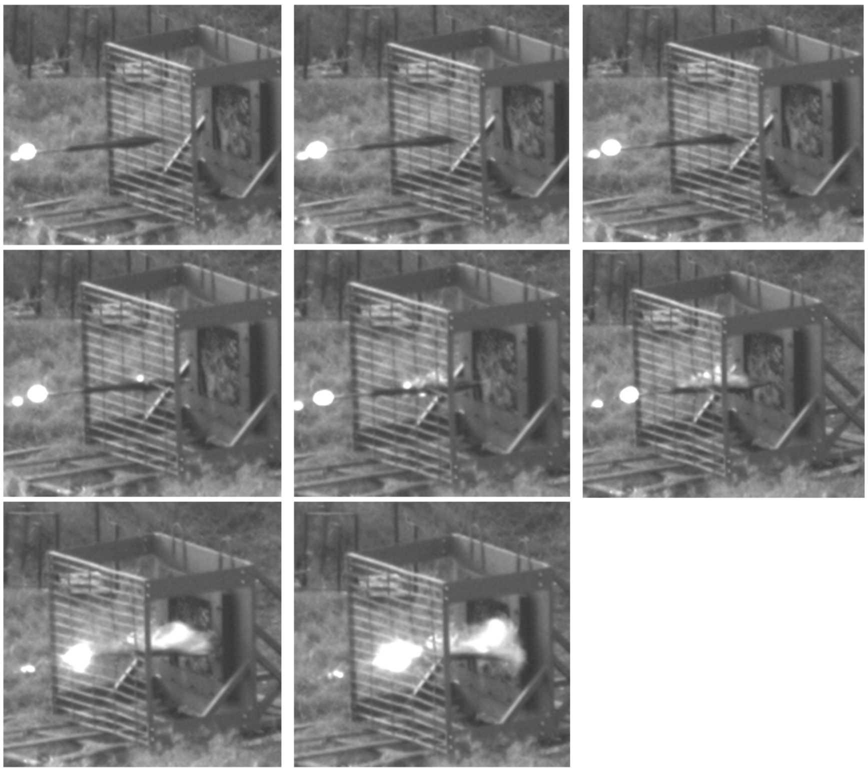


Fig. 2. Destruction of the grenade on the bar screen. Exemplary shots from the high speed camera

The protection probability for military vehicle crews is one of the four main parameters, which have impact on selection of the protection system. Other parameters include protection level characterized by threat type, system weight and its cost. For the ballistic resistance, in the bulletproofness tests, the probability of protection level of vehicle crews is calculated mainly as share of the armour surface resistant to perforation in the entire vehicle surface.

As regards bar or net screens, protection probability does not result only from area of vehicle surface covered by such screens but, due to conditions of occurrence of the mentioned above grenade destruction mechanisms, also from their structure, i.e. percentage share of the open space in the prepared vehicle protection. the open surface is a surface for which the flying grenade will not touch with its fuse the elements of structure and there is high probability of destruction of grenade without generation of the shaped charge jet.

2. The analysis of screen structures

The experimental research program using various types of screen material and structure solutions were completed within the development project no 0019/T00/2008/06, financed by the MNiSW. Tests were conducted with PG-7M grenades, with RHA steel perforation 300 ÷ 330mm (Fig. 3).

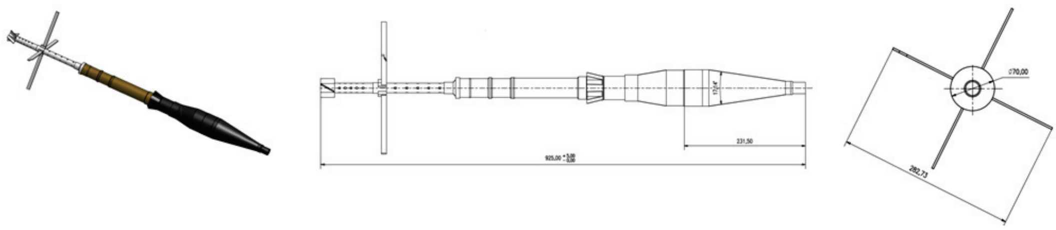
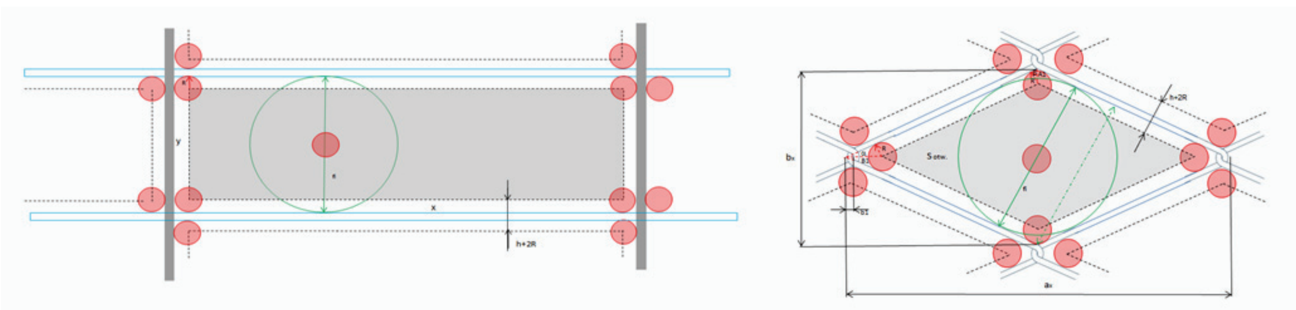


Fig. 3. PG-7M grenade diagram

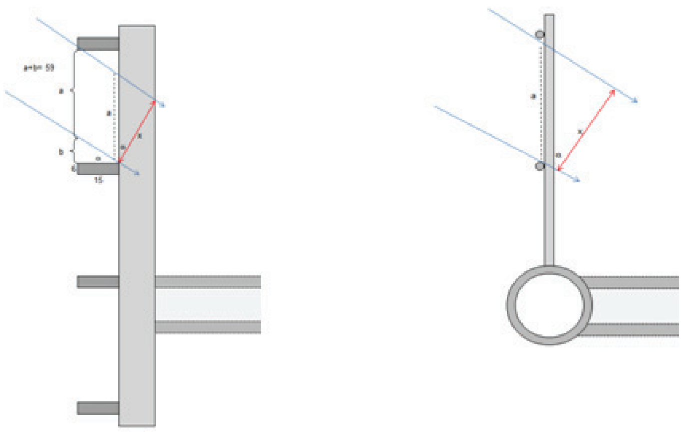
This article presents analysis of structures of elements composed of horizontal bars and the net, as regards analysis of the open space (Fig. 4) and weight only. The following were changed: thickness and width of bars and distance between them, thickness of wire and shape of individual net mesh. The materials used for construction of these solutions secured destruction of grenade according to mechanisms described above [5, 6].



a) b)

Fig. 4. The theoretical open space of individual mesh in the bar and net screen

The theoretical percentage analysis of the open space share was conducted for changes in angle of impact of grenade into screens, as regards elevation and azimuth (Fig. 5).



a) b)

Fig. 5. The cross-sections of the analyzed screens: bar and net one

Figure 6 and 7 present results of analysis of changes in the open space of the net screen (for single wire thickness and nine mesh shapes) and bar screen (for three thicknesses and five bar widths).

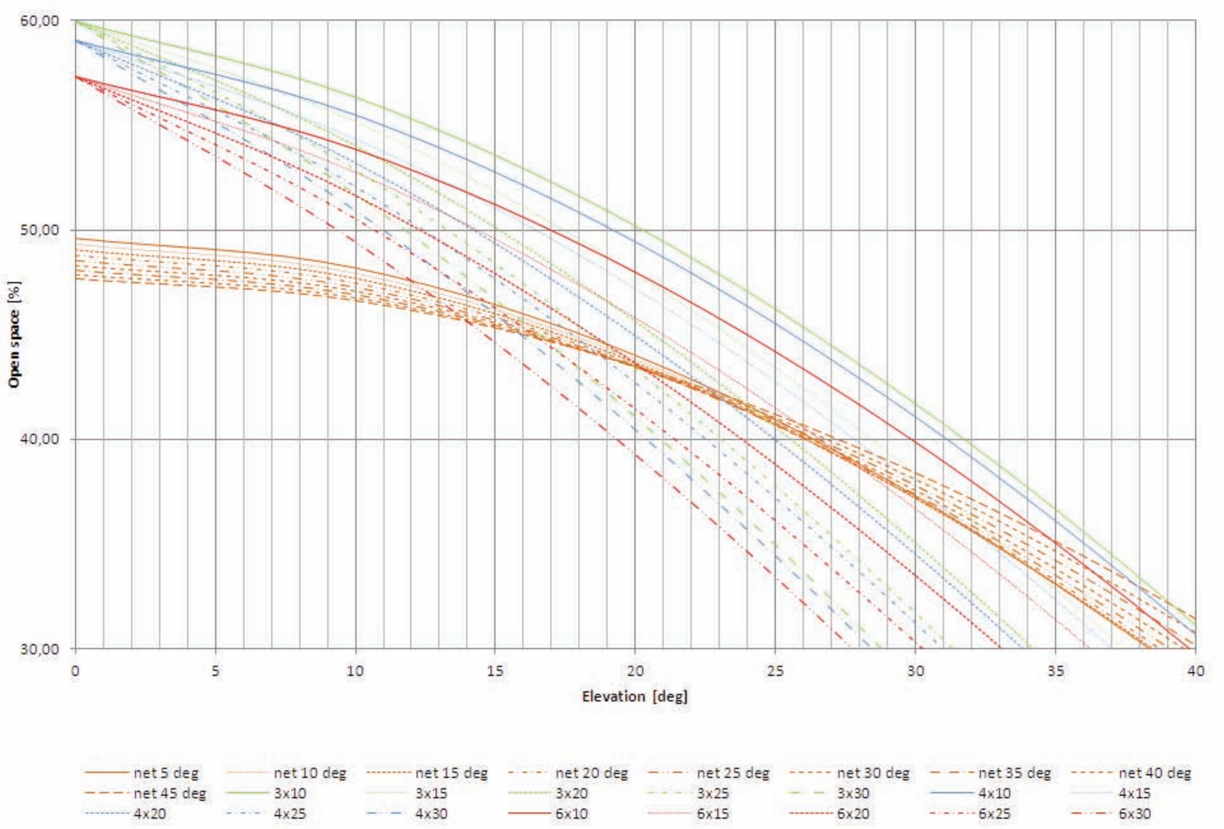


Fig. 6. The changes in the open space depending on changes in grenade impact angle in elevation

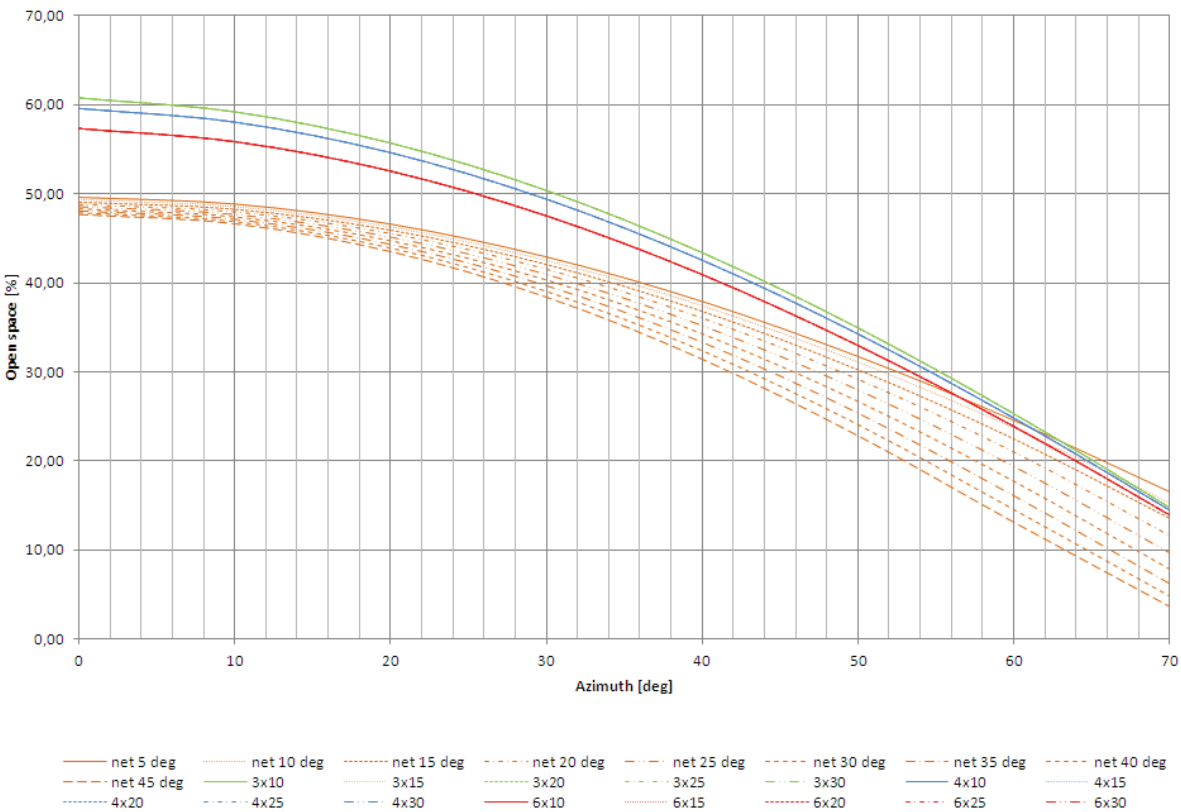


Fig. 7. The changes in the open space depending on changes in grenade impact angle in azimuth

The weight of screens was calculated within this analysis. Figure 8 presents results for module size 1500x1000.

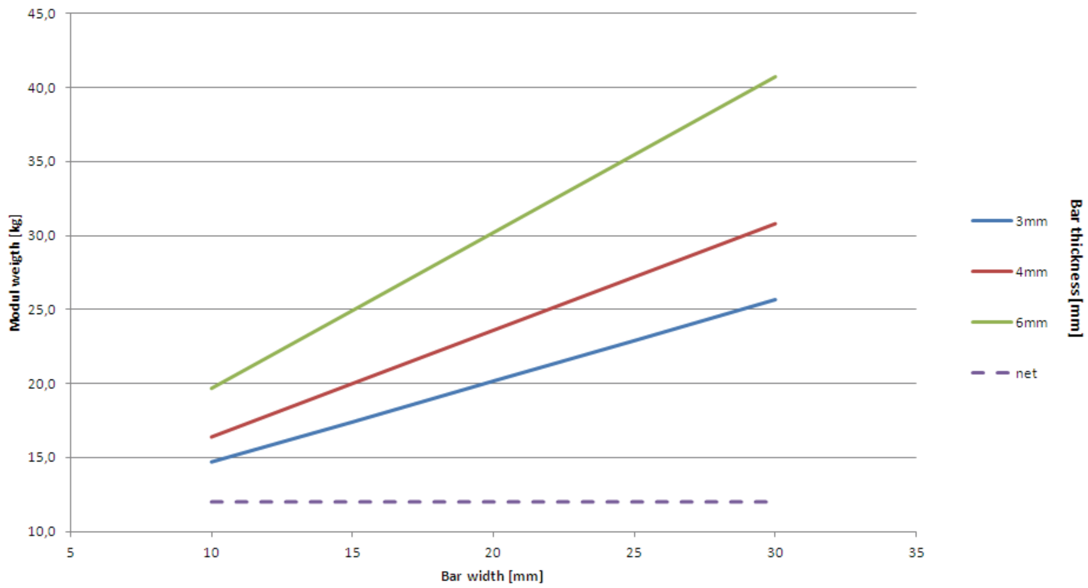


Fig. 8. the change of 1500x1000 module weight for the selected net and bar screen

3. Summary

The conducted tests allowed for selection of solution as regards construction of bar screen. The solution with the lowest weight and grenade destruction ability was selected. This solution was compared with the net screen offered currently on the market (Fig. 9).

The selected bar solution has larger open space than selected net screen for angles increasing in elevation, up to 30^0 value. For angles in azimuth, the bar screen has larger open space for the entire range of angles. The bar screens are heavier by minimum 50-60% when compared with net screens, but their operation costs are lower. They are repaired in field conditions. The damaged parts of bars are repaired only.

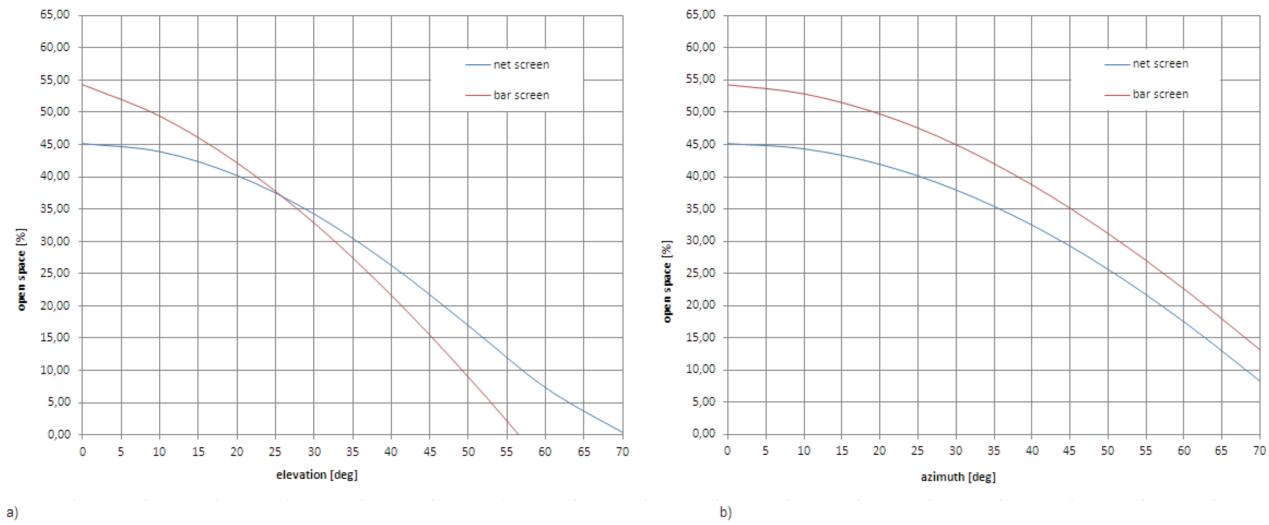


Fig. 9. The comparison of the selected bar screen (red line) and net screen (blue line). The function of the open space (calculated in percentage) on angles in a) elevation, b) azimuth

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