Kovács Zoltán

Physical perimeter security of military facilities

Permanent and temporary military facilities are extremely endangered by different violent attacks, e.g. armed, explosion, CBRN. The author shortly introduces the improvised explosive devices as the main weapons of blast attack, and highlights only a segment of the military facilities' physical security system: presenting the perimeter barriers and their application those may be used primarily to deny or hinder entering the vehicle born improvised explosive devices into the territory of a military facility.
Keywords: military facility, security, physical protection, perimeter protection, barriers, improvised explosive device, IED, VBIED

Introduction

Physical security includes those protective measures that are designed to deny unauthorized access to different facilities, installations, equipment, resources and documents, and to protect the personnel and property from damage or harm.

These measures include fieldworks, facility construction, detection and procedural elements. Procedural elements are the protective measures required by different military regulations or standing operating procedures and provide the basis for developing the other three elements. The construction method of the facility may include reinforced and blast resistant walls, doors, windows and roofs, whilst detection elements include technical segments like sensors, cameras, detectors and a human segment like armed security guards, operators. Fieldworks can be realized in the area surrounding the facility and technically includes perimeter barriers, landforms and standoff distances.

Improvised explosive devices

The Improvised Explosive Device (IED) is "a device placed or fabricated in an improvised manner incorporating destructive, lethal, noxious, pyrotechnic or incendiary chemicals and designed to destroy, incapacitate, harass or distract."[1]

The IED can take any form and be activated in a variety of ways. It may be constructed out of any available material and may range in size from a box of matches to a large vehicle. The only limitations are the availability of resources, personal ingenuity and the degree or extent of "know how" required for construction. The IED is usually fabricated from common materials, military or non-military components. It may be static in a fix location and detonated as an observed device when the moving target (e.g. a military convoy) is in the ideal position and distance from the device; or it may be a mobile bomb delivered near to or into a static, fix target (building, military base or military camp).

The most common explosives used for an IED are military explosives, such as C4 or SEMTEX plastic explosives, trinitrotoluene (TNT), commercial explosives, such as ammonium nitrate fertilizer and fuel oil compound (ANFO). However, some IEDs may contain homemade explosives (HME), which are kitchen-mixtures of different chemicals. Common hardware, such as ball bearings, bolts, nuts or nails can be used to enhance the fragmentation and cause more lethal or serious injuries in crowded places.[2]

The triggering mechanism may be victim operated, command controlled or time delayed. Generally, the most common version is the mechanical trigger, when the target gets into direct physical contact and push, pull, remove or release something that ignites the detonator. Time delayed constructions (clockwork, electric or chemical timers) independently operate the device after the pre-set time without any impact of the target. The command operated IED responds to a signal received via a hard wire or a radio frequency (wireless doorbells, car alarms, radio controlled toys, cell phones may be used).

For a successful attack it is very important to hide the device. Depending on its dimensions it may be covered in a harmless object such as a small tin or a paper bag, while bigger devices, which are mainly used against constructed military infrastructure, especially buildings, military bases or camps, can be hidden in the boot of a car or truck. These are the so called Vehicle Born Improvised Explosive Devices (VBIEDs), which are very effective, because they are an expedient method for transporting hundreds of kilograms of explosives to a great distance and can inflict severe damage on any military facility.

Basically, there are two common ways to use a vehicle as an explosive device. The stationary VBIED is when someone parks a truck or a car with full of explosives near to

1 STANAG 3680 NATO Glossary of Terms and Definitions (AAP–6), NATO Standardization Agency (17 November 2015), 431.

2 Kovács Zoltán: Az improvizált robbanóeszközök főbb típusai (Important types of improvised explosive devices),. *Műszaki Katonai Közlöny,* 22(2012)/2, 37–52.

the facility and detonates the IED by either wireless command or time delay. The mobile (movable) VBIED is when someone tries to break through perimeter barriers, drives the vehicle into the facility's territory and then detonates the IED and oneself. This is a suicide attack using a so called Suicide Vehicle Born Explosive Device (SVBIED).

Physical security system

It is fundamental to develop an integrated physical security system for the protection of a military facility. For comprehensive protection, the physical elements should be integrated with other security components and options, based on the features of the site and the identified threats.

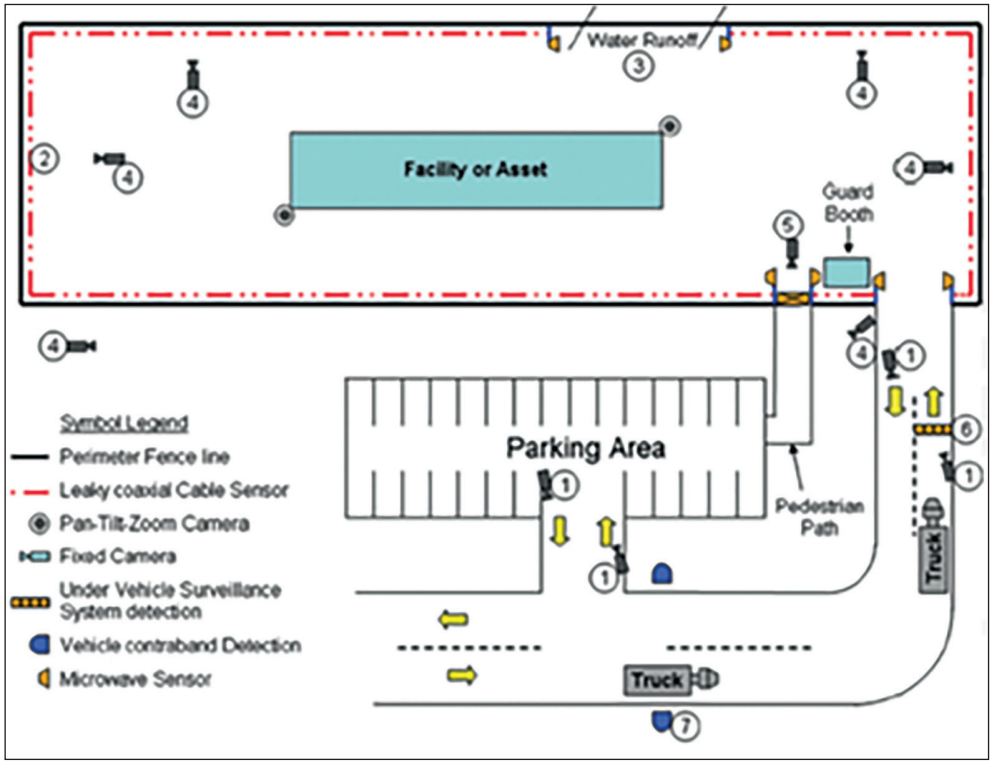

Figure 1: Combined security system[3]

3 *FEMA–426/BIPS–06: Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings: Buildings and Infrastructure Protection Series*, Edition 2. U. S. Department of Homeland Security (October 2011), 514. Source: https://www.dhs.gov/xlibrary/assets/st/st-bips-06.pdf

If risk assessment made before constructing a permanent military facility shows that an IED attack is surely expectable, the frame of the planned building should be reinforced and the glazing should be made of blast resistant glass. Structure of existing buildings also has to be hardened: carbon fibre polymers may reinforce concrete structures, side plates may reinforce steel trusses, different energy absorbing panels and synthetic coating can be used for absorbing and reducing blast effects. The existing and planned temporary military facilities (e.g. military camps) may also require special aspects to consider for reinforcement and hardening, blast and CBRN security or protection of public utilities, etc.[4]

Any reinforcement within the territory of a permanent or a temporary facility amplifies the function and effects of the first security zone, which is the perimeter around in standoff distance. The standoff distance is the maintained distance between an endangered facility and the place where a VBIED is allowed. The initial goal should be to make that distance as far from the target facility as practical, because the bigger the VBIED explosive load the greater the standoff distance necessary for reducing or minimizing the effects of the explosion.

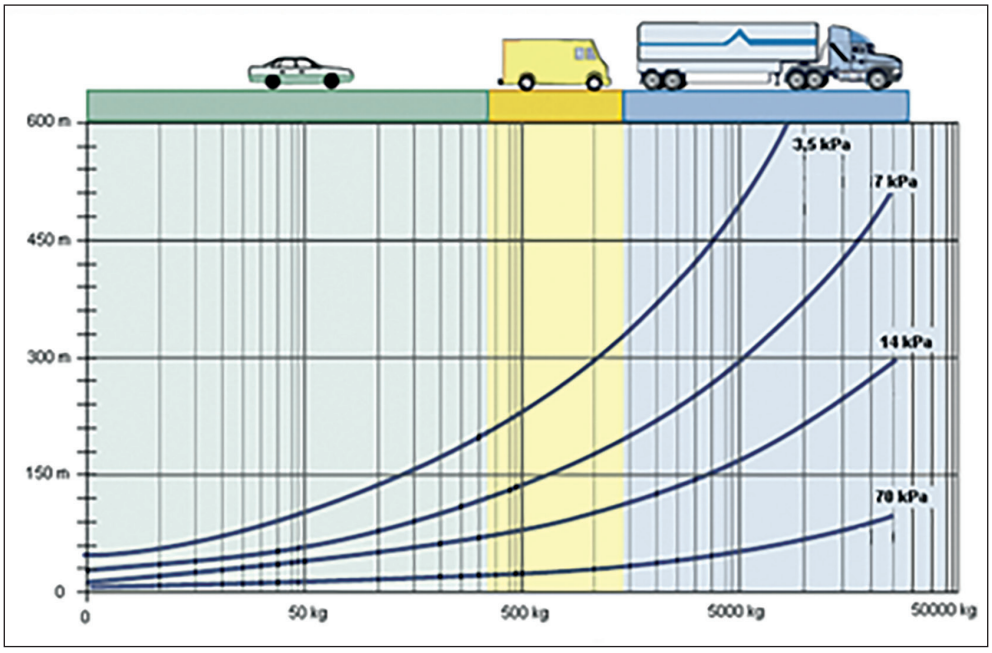

Figure 2: Standoff distance versus TNT weight[5]

4 Berek Tamás – Pellérdi Rezső: ABV (CBRN) kihívásokra adott válaszlépések az EU-ban. (Answers of EU for CBRN challenges),. *Bolyai Szemle,* 20(2011)/2, 55–72.; Kovács Tibor: A katonai táborok biztonsági rendszereinek kialakítása, különös tekintettel a robbantásos merényletek megelőzésére, azok hatásai csökkentésére. (Security system of military camps, with especial regard to prevention of blasting attempts and reduction of their effects),. *Műszaki Katonai Közlöny,* 22 (2012)/3, 70–83.; Dénes Kálmán: Aspects of water supply and sewage systems in military camps,. *Bolyai Szemle,* 20(2011)/1, 163–172.

5 FEMA–426/BIPS–06…, op. cit.

When a military camp is located on an open area, it is easy to provide considerable space for standoff, therefore conventional construction with minor modification on terrain may reach an acceptable level of protection against a VBIED blast. But in many cases, it is very difficult to achieve and maintain the required standoff distance. As the chart above shows, a small change in standoff distance can make a large difference in the blast loadings: bigger distance reduces the peak pressure and the impulse of blast.

If distance is less than necessary, other protective elements should be improved, like structural hardening or reinforcement, more perimeter barriers, high-tech detection devices. The required security standards for each threat levels concerning military camps or buildings are declared in different documents and handbooks.[6]

Financial resources determine and even terminate all the conception, this is why engineers and security experts should find balance between the costs and quantity/quality of protection elements necessary to reach the required security level. If standoff distance increases, the perimeter should be longer around the territory, which requires more barriers, fences and detection equipment increasing the costs of perimeter security.

On the other hand, increasing the distance means that other security elements may be reduced, which requires less investment. During searching the balance always remember that standoff is the best friend and perimeter barriers are primarily for denying unauthorized access, they do not perfectly protect against blast effects!

Perimeter security barriers

The difference between movable and stationary VBIED tactics is that the aggressor using the moving vehicle bomb will attempt to crash through the perimeter; the aggressor using the stationary vehicle bomb will not.

Once the standoff distance for a facility has been established (based on the expected amount of explosives and acceptable damage level), the threat vehicle should not be allowed to get closer to the facility where a greater level of damage could occur.

The moving vehicle produces kinetic energy that must be absorbed by the perimeter barrier to effectively stop the vehicle. This energy can be calculated by the weight and speed of the vehicle. It is very important to control the speed of the vehicle approaching the barrier, because the energy from a vehicle that a barrier must stop increases quadratically as

6 STANAG 2280 (Edition 1) Design Threat Levels and Handover Procedures for Temporary Protective Structures, NATO Standardization Agency (18 December 2008), 28.; Field Manual 3–19.30 Physical Security. HQ U. S. Department of the Army (8 January 2001), 317.; Unified Facilities Criteria (UFC 4-022-02) Selection and application of vehicle barriers, Change 1, US Department of Defense (9 August 2010), 101.; Unified Facilities Criteria (UFC 3–340–02) Structures to Resist the Effects of Accidental Explosions, U.S. Department of Defense (5 December 2008), 1943.; Unified Facilities Criteria (UFC 4–010–01) Minimum Antiterrorism Standards for Buildings, Change 1, U.S. Department of Defense (1 October 2013), 111.

its speed increases. The best way to limit a vehicle's approach speed to perimeter barriers is to place obstacles in all potential approach paths. The vehicles are forced to reduce speed when going around these obstacles placed in a serpentine pattern on the road. If the vehicle hits the obstacles instead of going around them, they are still slowed down. Curved roads and roadways with chicanes, road humps or sharp turns where a vehicle is forced to make a short radius turn before impacting the barrier will also effectively reduce its speed.

Perimeter barriers designated to stop or hinder vehicles may be categorized as either active or passive. Both of them can be fixed or movable, depending on how they are made, operated or used. An active barrier requires some action, either by personnel, equipment, or both to permit entry or exit of a vehicle. Active barriers include barricades, bollards, beams, gates, and active tire shredders.

The passive barrier has no moving parts, their effectiveness relies on their ability to absorb and transmit the energy to their foundation. Jersey walls, bollards or posts, guard-rails, ditches and reinforced fences are good examples of passive barriers.

The fixed barrier is installed permanently and requires heavy equipment to dismantle (e.g. concrete or steel barriers, fences), the movable barrier can be relocated from place to place but it may also require heavy equipment to assist in the transfer.

Fences should not be considered as protection against a moving VBIED attack. Most wire fences can be easily penetrated by a vehicle and will resist impact only if some reinforcement is added. The true value of a perimeter security fence comes in its association with other components of the security system. They are primarily used to provide a legal boundary by defining the outermost limit of the military facility. However, they may also assist in controlling and screening authorized (vehicle) entries into a secured area and providing a "clear zone" for installing lighting, intrusion detection equipment and cameras. Fences are frequently combined with barbed concertina wires to prevent human trespassing, too.[7]

As the perimeter for permanent military facilities a strong masonry wall made of brick, concrete or reinforced concrete blocks is the best solution against VBIED attack. For temporary military camps the HESCO bastions and DEFENCELL system should be appropriate as perimeter protection. Their elements filled with soil, gravel or sand allows raising even a 5–6 meters high protective wall around the base.

If very high walling is not necessary due to lower VBIED threat, the 2-meter-high Jersey-wall elements interlocked together may also be appropriate for protection. These barriers can provide protection through their mass (a 3-meter-long Jersey barrier weighs approximately 1.8 tons) but when placed on the ground surface, they may be ineffective against heavy vehicular attack. Therefore, they need to be embedded and include vertical anchorage of steel reinforcing through the barrier.

7 Padányi József: Műszaki zár a határon (Engineer barrier at the border). *Műszaki Katonai Közlöny,* 25(2015)/3. 21–34.

At permanent facilities the protective walling can be supplemented with other types of barriers as fix bollards and beams made of steel or concrete. At a temporary facility the triangular or rectangular log cribs, log hurdles, ditches, steel or concrete hedgehogs and tetrahedrons, concrete cubes, 200-liter drums filled with sand may also be parts of the perimeter security system. Spacing between these barriers should not exceed 1–1.2 meters, depending on the expected threat.

Figure 3: DEFENCELL protective wall[8]

Whilst passive barriers mentioned above are normally used for perimeter security, the active vehicle barriers are mostly located at facility entrances, entry points (gates) or selected interior locations (entrances to restricted areas).

As one of the active barriers of permanent facilities, the retractable bollard system consists of one or more rising bollards operating independently or in groups of two or more units. Bollards can be raised or lowered by a buried hydraulic or pneumatic power unit, controlled remotely. Typical retractable bollards are 30–35 centimetres in diameter, up to one meter high, and are usually mounted 0.8–1.0 meter apart, depending on expectable VBIED threat. The bollard operating time is adjustable and ranges from 3 to 10 seconds. Emergency operating systems can raise bollards in 1.5 seconds.

Another active element, the rising wedge barrier can be surface mounted or mounted in a shallow excavation. Raised heights are from about 0.5 to 1.2 meter and the standard width is 3 meters. In surface-mounted installations all components are above ground and no cutting or excavation is required on concrete or asphalt surfaces.

8 *DefenceCell: Advantages.* Source:, http://www.defencell.com/advantages_home.html (11.03.2016)

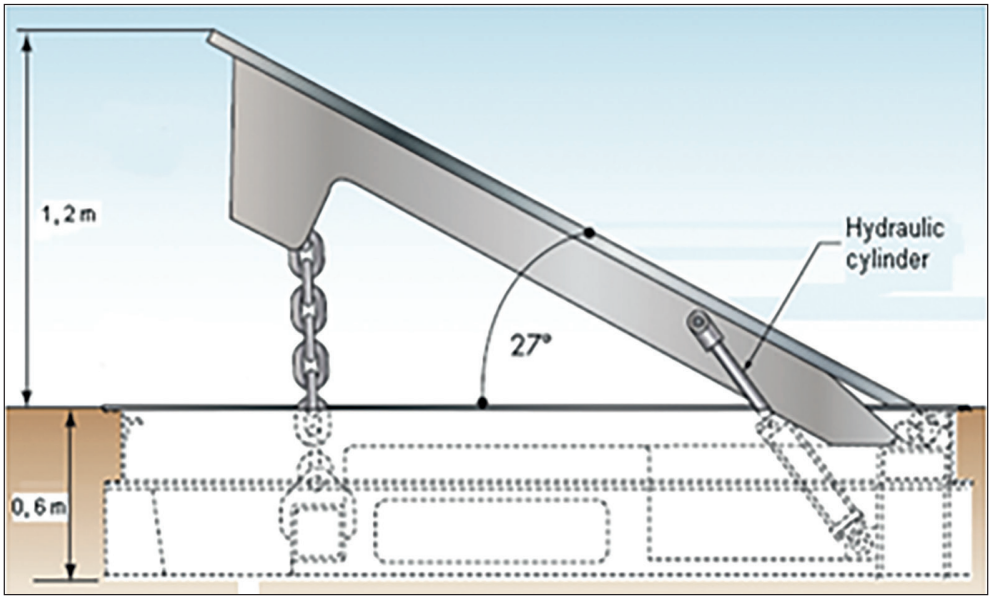

Figure 4: Rising wedge barrier[9]

The rotating wedge is similar in action to the rising wedge barrier but it has a curved front face providing a better appearance, and is embedded to a greater depth. The height of this obstacle is between 0.5 and 0.8 meter, the standard width is 3 meters. It is operated hydraulically by heavy duty rams, and the operating time is about 2–3 seconds per movement.

Besides the active barriers introduced above, crash beams and gates should function as a barrier, too. Beams are usually counterbalanced and lift at one end to allow vehicle access. This system is frequently used for low impact conditions when vehicle speed can be limited and as an interior barrier after a primary high impact barrier. The crash gates include both sliding and swinging styles, the clear opening range is from 4 to 9 meters and the typical height is between 2 and 3 meters.

The constructed active barriers above are mostly used at permanent military facilities and buildings. The active barriers for a temporary military facility (e.g. a camp) may include blocks in different shapes and made of steel or reinforced concrete. They should have handles for relocation and also require a heavy equipment to assist in the transfer.

9 FEMA–426/BIPS–06..., *op. cit.*

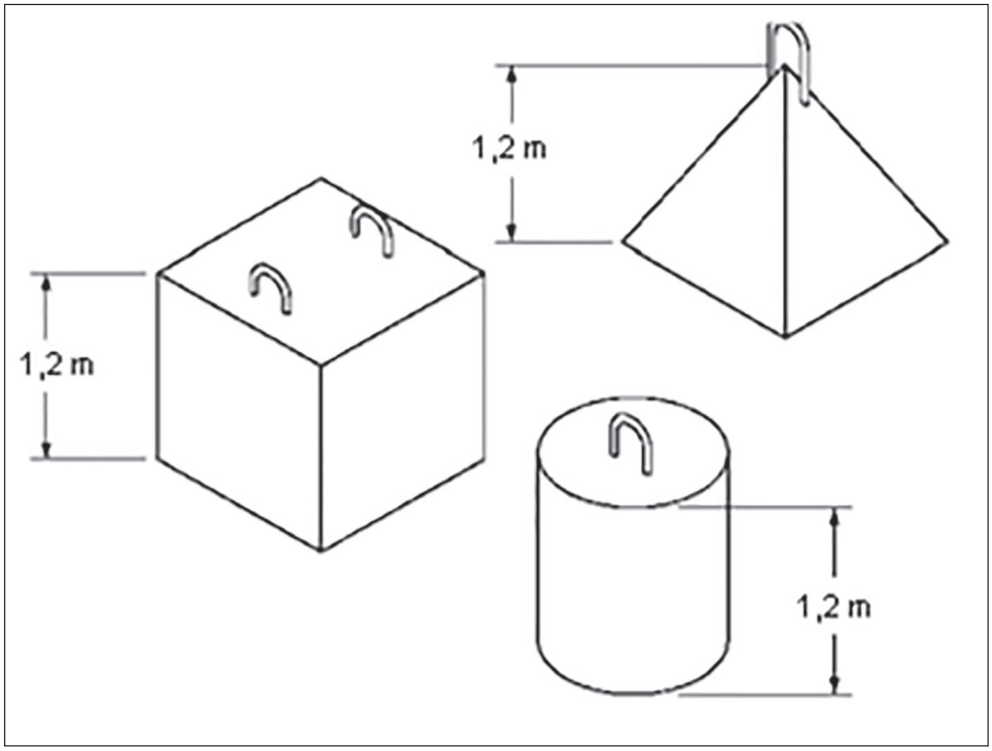

Figure 5: Reinforced concrete blocks[10]

Bars and gates used at entrances of military camps are weaker constructions than those used at a permanent facility. They are operated by hand, since hydraulic or electric sources are usually not available. Movable tire shredders causing flat tire can be also used against wheeled vehicles, forcing them to slow down.

Mobile wedge barriers which can be moved into position by a truck in a few minutes also exist. These can form an effective element of a planned temporary barrier system to respond to a heightened VBIED threat.

10 Unified Facilities Criteria (UFC 4-022-02)..., op. cit.

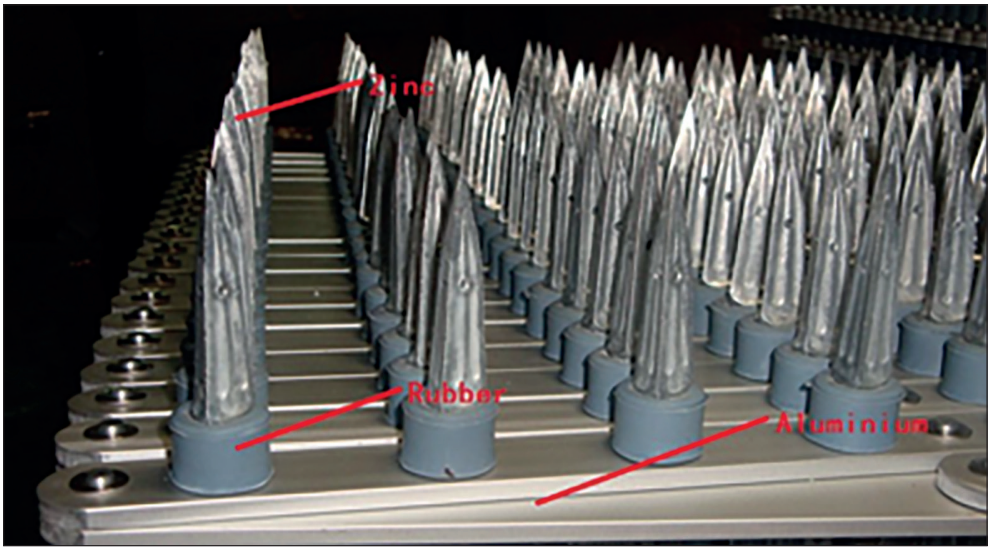

Figure 6: Tire shredder[11]

Summary

Military facilities are highly endangered by terrorist blasts. Basically, there are three ways to perpetrate an IED-attack against a military facility. First, when someone hidden from view tries to take a bomb into the facility, second when detonates outside, near to the facility perimeter and third when tries to break through the perimeter with a vehicle. The first case may be prevented with strict explosive detection, the second one with appropriate standoff distance, the third one with strong walling and perimeter barriers.

Inflicting serious damage on a military facility requires adequate quantity of explosives, and vehicles are the perfect method for transporting these explosives. A movable VBIED can appear anywhere and may cause higher threat than a stationary one.

Vehicle barriers for a movable VBIED must be capable of stopping the moving vehicle at the perimeter. For a stationary vehicle bomb, vehicle barriers must only mark the perimeter of the standoff zone, but they are not required to stop the moving vehicle.

The number of gates and perimeter entrances must be the minimum required for safe and efficient operation of the facility. When closed, gates and entrances must provide a barrier structurally comparable to their associated barriers.

The most important segments for security are keeping adequate standoff distance around the facility, forcing moving vehicles to slow down before they impact the barriers and having a well-designed, strong, effective physical security system.

11 Source: http://img.alibaba.com/img/pb/835/261/370/370261835_473.jpg (11.03.2016)

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Katonai létesítmények fizikai védelme

KOVÁCS ZOLTÁN

Az állandó és ideiglenes katonai létesítmények rendkívül veszélyeztetettek a különböző támadások (fegyveres, robbantásos, ABV) által. A szerző röviden bemutatja a robbantásos cselekmények fő eszközeit, az improvizált robbanószerkezeteket, valamint a katonai létesítmények fizikai védelmi rendszerének egyik szegmensét: azokat az eszközöket és alkalmazásuk lehetőségeit, melyek elsősorban a gépjárműben elrejtett robbanószerkezetek katonai létesítménybe történő bejutását, bejuttatását hivatottak megakadályozni, megnehezíteni.

Kulcsszavak: katonai létesítmény, biztonság, fizikai védelem, határvonal védelem, akadályok, improvizált robbanószerkezet, IED, VBIED