# Protection of Borders and Installation against Vehicle-based Attacks

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**Abstract**

**An explosive device, within a vehicle, is a common means of attack. In most of the practical cases, the driver approaches the target building, by vehicle, with a full load of explosives and often sacrifices their life. Finally, this may result in a total building collapse and environmental destruction. The aim of this article is to summarize security strategies and techniques of vehicle barrier construction and to introduce a history of vehicle barriers.**

**Keywords: terrorist, HVM, VBIED, perimeter protection, security**

## Introduction

Because of the lack of early sources and precise descriptions, this article presents the opinion of the author regarding the history of development of vehicle obstacles. The description is not exhaustive, as it contains only the major "milestones" of military and civil spheres that are considered significant, by the author.

## I. PERIMETER PROTECTION IN THE PAST

### *I.1. Military use*

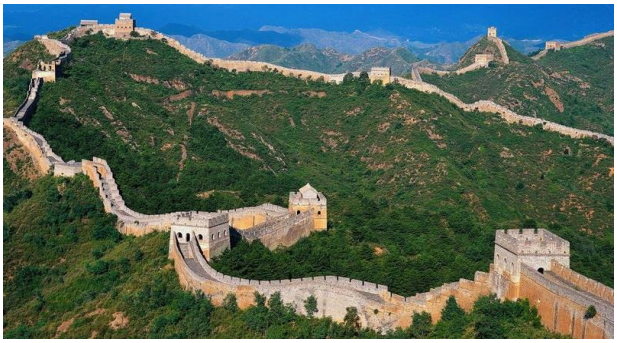

Figure 1. The Great Wall of China [1]

When it comes to territory protection, most people think first of the Great Wall of China, built around 220 BC. The length of this non-continuous structure is estimated at 7,000 kilometres (4,370 miles) and it stretches across rocky, swampy, and desert areas. The primary role of one of the World's most ancient military structures was to defend the empire against the attacks of the northern nomadic people. The parameters of the wall are incredible, with a height of 10 meters (over 30 feet), its widths at the base and at the top were 7-8 meters and 4-5 meters, respectively. The wide top allowed ten infantry soldiers or five cavalrymen to march in a line abreast along it. In wartime troops could move along the wall and it was also used for transportation of weapons and food. At that time, military power was represented by massive infantry and cavalry (besides destructive war-machines). [2] [3] [4] [5] [6]

Figure 2: Chariot of the age of Pharaoh Tutenkhamen, and lancers driving a cart [7] [8]

Figure 3: Egyptian chariot [9]

It is important to emphasize, however, that in the ancient world – as early as around the 3rd millennium BC – primitive carts were already in use in Mesopotamia – although their primary role was more of a logistic nature – transporting mounted archers and lancers. Then chariots were further developed by the Hittites and Persians and as a result chariots with spoked wheels and later also with sickles were introduced. The chariot is regarded as the forefather of the first battle tanks.

Over the years a great number of wars followed, and the early 20th century, in fact 1916, saw the first operational battle tank, named the Mark I by the British, on the battlefields of the Somme River, France. The new tank was developed in order to protect the advancing soldiers and with the use of its armament to provide support to the infantry attacking with the intent to break through the enemy lines. The Mark I suffered from a number of weaknesses, because its crew consisted of 8 people, it was extremely difficult to control, its speed was merely 8-10 kph (5-6 mph), its range was barely 40 kilometres, it was equipped with tracks without spring-mounted suspension, and it often got bogged in the mud.

Figure 4: German medium tank SdKfz 161 Panzerkampfwagen IV/ Panzer 4 [10]

Figure 5: A Soviet T-34 tank [11]

By the Second World War, the armour protection, firepower and mobility of tanks, had evolved considerably. Thanks to their increased firepower, armour piercing capability, cross-country capacities, and mobility, main battle tanks played an important role in the theatres of war, playing the role of the significant "ace trump card" on both the offensive and the defensive sides. [12]

According to one school, the introduction of the new machinery encouraged all participants, in the war, to manufacture stronger and faster battle tanks, which were able to adapt to different situations almost anywhere. [13] The other school comprised a defensive stance, impeding methods against armour.

The first, primitive, and the subsequent battle tanks manoeuvrability, mobility, and cross-country capability were all very limited. These combat vehicles could not be deployed, or only to a limited extent, on steep, rocky, muddy, or swampy, terrains. If the mission was to defend an area which constituted a terrain easy to pass, it had to be converted into a difficult terrain.

The Dragon's Teeth and Hedgehog in the pictures below are vehicle barriers serving this purpose. [14]

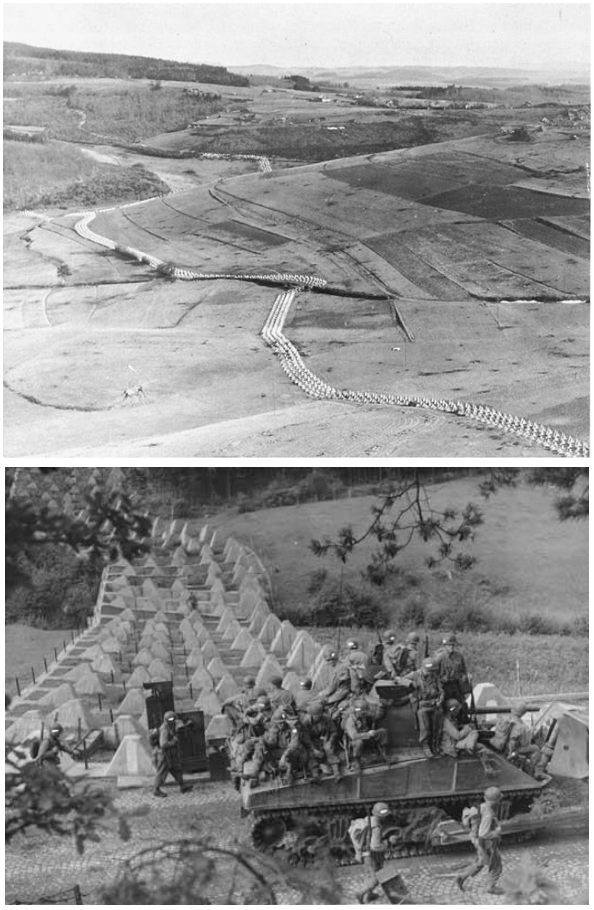

Figure 6: Limiting the flow of traffic with the use of Dragon's Teeth [15] [16]

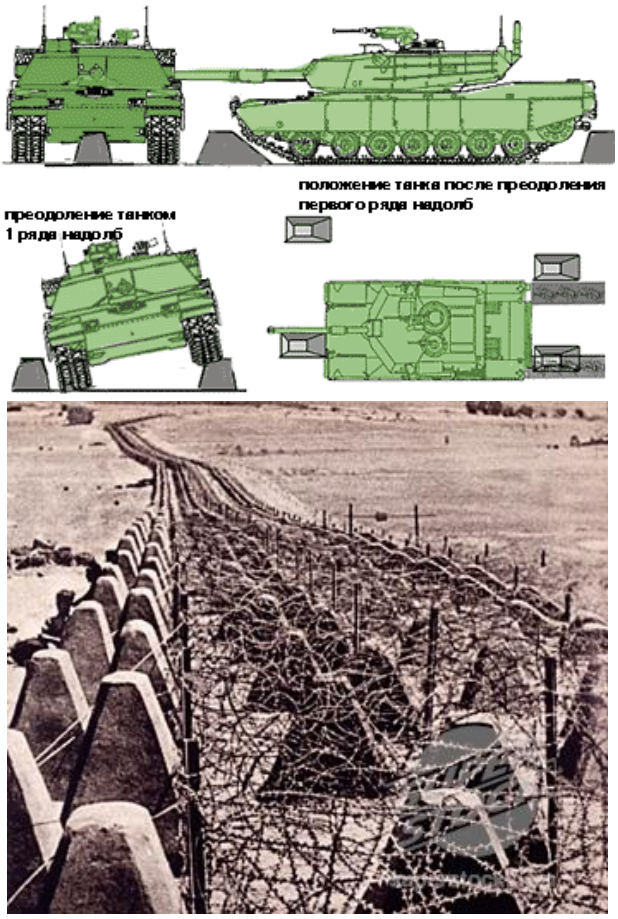


Figure 7: The mode of operation of Dragon's Teeth [17] [18]

Figure 8: Improving the efficiency of Dragon's Teeth with explosive charges [19]

Figure 9: Coastal barriers (hedgehogs) [20] [21]

Figure 10: Obstacles to combat vehicles [22] [23]

The purpose of both types of obstacles was to make it difficult or obstruct combat vehicles movement on a given terrain, thus allowing the defence to have sufficient time for the destruction of such vehicles. These obstacles were used in the best-known areas of World War I and II such as:

- the Siegfried Line [24]
- the Maginot Line [25]

The battle tanks of our time usually have only 3 to 4 member crews, significant cross-country capacities, as high as 80 kph speed and a combat range of 500 to 700 kilometers. [26] [27] [28] [29] [30] [31] [32] [33]

*I.2. Civil use*

Road accidents take the lives of millions of people every year, even nowadays. The accident factors range from tired, inattentive, impatient drivers to unfavourable external conditions result in a vehicle sliding into the opposite lane and frontally colliding with a vehicle from a reciprocal direction, falling into a gap or capsizing.

In order to reduce the number of road accidents, their injury and death risks, the US Congress approved the National Traffic and Motor Vehicle Safety Act. Its purpose is to encourage the elaboration of vehicle safety solutions and standards, such as seat belts, energy-absorbing pillars, steering columns, guard rails, shock proof door locks and highly impact-resistant windscreens. This measure ensured that a new branch began develop within the marketplace – vehicle safety. In the 1970s crash tests began and in dependence on the results the testing of various safety devices followed. The testing methodologies and standards of that era comprise the fundaments of the current reformed standards. [34]

*I.3. Means of modern urban perimeter protection*

The warfare of present times has increased and incorporates an asymmetric warfare, which may be interpreted in several ways. [35] What is important for the topic of the present paper is that in achieving victory, the opposing parties frequently "play with cards" which the other party does not possess, or a given action exceeds a certain ethical limit.

Vehicle borne improvised explosive devices (VBIEDs) fall into this category as this method of explosion may be classified as a typical terrorist technique, which is unethical, because such attacks, frequently involve civilians.

The security devices and measures developed in the 1970s and 1980s proved inefficient against attacks conducted with the violent use of vehicles. Vehicle barriers used by the military represented a trend which proved to be efficient against violent actions and technical assets; however, they could not be integrated in urban environment or in an inhabited area. Their large sizes, great number of components, the primary and secondary impacts generated by their use are unacceptable or inapplicable in (densely) populated areas.

After the 1980s, a series of standards were issued in the USA, then in Great Britain and Germany, which set forth

the requirements for vehicle barriers and their classifications and deployment strategies.

## II. THE CLASSIFICATION OF PERIMETER DEFENCE DEVICES

Perimeter defence solutions may be classified on the basis of their operation, structure, resistance capacity and energy absorption or kinetic-energy diversion.

On the basis of their operation, passive and active devices can be classified. The latter structures may be divided into two groups:

- Hydraulic
- Electromechanical

Figure 11: A mix of vehicle barriers in activated position [36]

On the basis of their structure these barriers can be retracted into the ground, rising barriers, swing barriers, or barriers moving horizontally on the ground. An important factor of the structuring, is the protection against a vehicle category.

Resistance is another significant factor for categorisation because different structure and the use of different materials for construction result in different resistance levels. It is an unavoidable element of the design phase, as different vehicles have different masses, accelerations and resultant terminal velocities.

The role of energy absorption and that of driving is a priority when the buffer area designated for the protection of a given area is extremely limited.

## III. CONCLUSION

Designing and establishing protection against vehicle-borne attacks involve a great number of life protection and property protection factors, which is clearly illustrated by the brief historic overview of military and civil vehicle barriers. The more complex the area to protect and its perimeter, the more complex and difficult the planning and design phases are. Factors such as environment, various road structures, the range and working requirements of potential technological assets need to be taken into consideration.

VBIED comprises a special category of vehicle-borne attacks, where apart from deliberate destruction caused with the use of a vehicle, the primary impact (shock wave, heat effect, and fragmentation effect) and the secondary impact of hidden or transported explosive device have to be taken into consideration.

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