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Explosives and burglary resistance of barriers. Determination of burglary resistance factors.

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Abstract. The explosion has various effects on its environment. The barriers, unless there is a requirement, are not designed for the specific blast load. There are currently no technical standards that regulate the resistance of commonly used elements of mechanical barriers exposed to a blastwave. Current technical standards focus on the resistance of certain elements, structurally made in a way to improve their resistance against the effect of explosions. These technical standards are used to certify elements into various classes of blast resistance. The paper is focused on the problem of determining the burglary resistance factors when explosives are used to overcome the mentioned barriers.

1 Introduction

The burglary resistance of an asset protection system can simply be described as the time in which the attacker overcomes protection barriers. The time is the sum of the burglary resistances of the individual elements of the assets protection system. The issue of burglary resistance and the issue of asset protection systems are researched in scientific and professional literature [1],[2],[3]. A special part is the protection of objects important for the operation of the state [4],[5] and [6].

An important factor in assessing burglary resilience is the type and the motivation of the attacker and the means used to overcome the barriers [7]. This directly affects the method of committing the act - the method of overcoming the protection barriers and the entire system of protection of the assets.

Tools that can be used to overcome mentioned security barriers can be divided into categories ranging from improvised tools to high-efficiency devices such as high-performance power tools described in [8] and [9]. In the case of explosives, we can speak of a non-standard device. The technical standards regulate the burglary resistance using explosives only for secure storage units [10]. The paper aims to address the specifics of burglary resistance of barriers with the use of explosives to overcome them.

1.1 Factors influencing the effect of an explosion

The effect of explosives on the assets and the surrounding environment is a complex topic, which is devoted to many scientific and professional publications [11],[12],[13]. To express these effects in detail, it is necessary to know the processes during the explosion, as well as

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the characteristics of the destroyed assets and the characteristics of the used explosive charge, in details studied in [14], [15] and[16].

The following factors affect the assessment of the effects of an explosion:

- Characteristics of the destroyed material/destroyed asset (type of material, dimensions etc.).
- Characteristics of explosives, resp. type of explosive.
- Charge characteristics (geometry, dimensions, construction).
- Mutual arrangement of the assets and the charge.

In simplification, the key factors describing the effects of an explosion are the used tools (charge and explosive), the destroyed asset and their mutual positions. If the effect of the explosion on the surrounding environment is also of interest, then it is necessary to add the characteristics of the environment, resp. assets in this environment [17], [18]. The environment surrounding the explosion site is mainly affected by a pressure wave.

The construction of the charge and its location has a significant effect on the energy released by the explosion. We present two basic types of charges according to their shape [11]:

- Concentrated charges where the basic shape is a sphere or a cube. Typically, all dimensions are approximately the same, the blast wave propagation is demonstrated in Figure 1.
- Typically, one dimension far exceeds the other two dimensions.

The explosion can be directed by the shape of the charge. According to the charge guidance, we divide the charges into cumulative charges (Fig.2), i.e. those where the energy of the explosion is in one direction many times greater than in the other directions. The second types of charge according to the guidelines are non-cumulative charges, where the energy of the explosion is approximately the same in all directions [11].

The arrangement of the charge and the asset is determined by the location of the charge on the assets (attaching the charge to the asset, fixing the charge to the asset) or in the asset in a pre-prepared hole or natural hole and its possible packing.

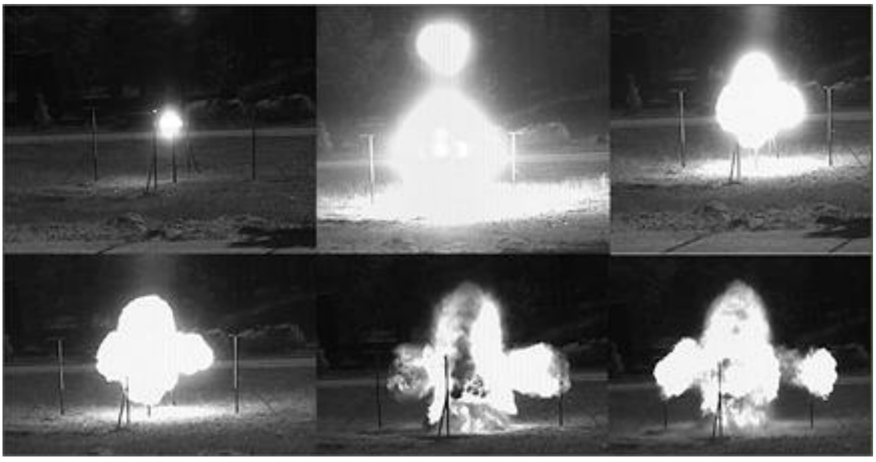

Fig. 1. Pressure propagation - explosion of a concentrated charge

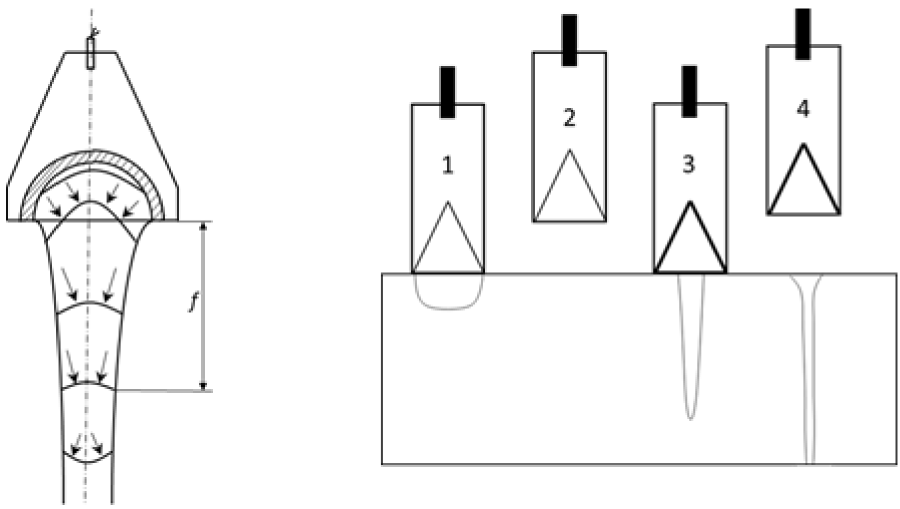

Fig. 2 a) Cumulative charge scheme [11] b) Effect of cumulative charge [8]

1.1.1 *Charge and asset arrangement*

As mentioned above, there are two basic situations of arranging a charge and a asset:
1. The charge is attached to the asset (Fig. 3a)
This is the easiest way of all charge placement options. The charge can be placed on the ground or above the ground. The height of the charge has an effect on the pressure reflection during the explosion [11].
2. The charge is in the asset
A wide range of situations can occur when placing a charge in an asset. The origin of the hole for a charge has an impact on the assessment of burglary resistance because the creation of a hole by the attacker prolongs the time and presupposes the use of other tools.
a) Placing the charge in the hole created by the attacker in the asset requires preparation - the creation of the hole and also the use of other tools (toolsets). The creation of a hole can attract unwanted attention to the attacker's actions and also affects the time of the act of overcoming the security hardware. The type of tools used to create the hole must be taken into account in the assessment.
b) Placement of the charge in a natural hole, resp. use of geometric shape, construction and natural characteristics of the destroyed object. In this situation, it is not necessary to make a hole for the charge. The charge is located in a space that is part of the element.
In addition to the origin of the charge placement hole, the depth of the charge in the hole is important. Deeper placement of the charge reduces the demands on the amount of explosive, as it reduces the thickness of the torn material.
a) A charge placed at a minimum depth below the surface of the object (Fig. 3b).
b) A charge placed at a depth of 1/3 the thickness of the object (Fig. 3c) [19].
c) A charge placed at a depth of 1/2 the thickness of the object (Fig. 3d) [19].

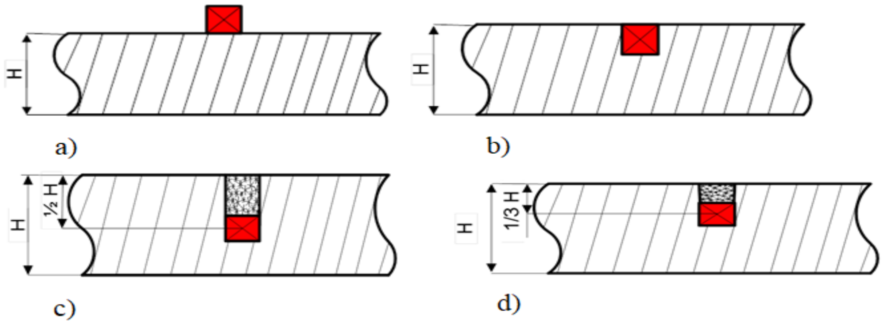

Fig. 3 Charge and asset arrangement [11]

1.2 Parameters determining the burglary resistance using explosives

Burglary resistance of protection barriers is regulated by technical standards [10], [20], [21], [22], [23]. Technical standards regulate:

- the size of the hole for complete and partial destruction of the barriers
- security classes for individual elements (walls, doors, windows, secure storage units, etc.)
- tools and tool sets designed to overcome the barriers
- time of burglary resistance.

Technical standards in the field of burglary resistance also regulate the procedure of certification of barriers and testing documentation.

The use of an explosive as a tool to overcome the asset protection system is specific because the value of burglary resistance is not possible expressed by time. The duration of the explosion is very short, and the effect occurs almost immediately. The sum of time has an impact on burglary resistance:

- time required for final preparation of the charge resp. for the construction of the charge,
- time required to place and pack the charge,
- time required to prepare the detonation of the charge,
- time needed to cover and return the attacker to the scene of the explosion.

Each of these times is determined by a subjective and objective side. The subjective side is given by the person of the attackers and their ability to commit such acts [24]. The objective side is given by the element (shape, durability, material) and the surrounding environment (shelter, rugged terrain) [25], [26].

In addition to the time, it is necessary to take into account the effect of the explosion and the factors that affect it in terms of burglary resistance as they were described above. These are objective factors, but they are the attacker's choice. The burglary resistance of elements using explosives can only be tested and quantified with these specified factors, and each type of element must be approached separately.

Conclusion

The effect of an explosion is influenced by many factors. If we talk about explosives, as a tool for overcoming the asset protection system, then in addition to the effect on the asset to be overcome (element of the asset protection system), the effect of the explosion on the surrounding environment is also important. The explosion can damage surrounding assets, endanger the attackers and alert them to their illegal actions. It is necessary to deal with the quantification of the burglary resistance of elements when explosives are used to overcome them, as well as their testing. Procedures must include a time factor as well as an explosion energy factor. These factors include objective and subjective factors that need to be quantified for the calculation.

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