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Ad hoc hiding constructions used to protect civilians

Zbigniew SZCZEŚNIAK* [1] and Janusz LALKA [1]

[1]Military University of Technology, Warsaw, Poland

Abstract

Ad hoc hiding buildings are a cheap and fast implementation element supplementing the stationary protective infrastructure useful in crisis situations. As part of the work, the most commonly used emergency shelters were discussed. Their basic parameters and methods of strength tests were discussed.

Keywords: hiding construction, shelter

1 Introduction

Shelters are used to support civil protection and civil defense projects in Europe [9, 13, 16]. In most countries, appropriate legal, financing and technical principles have been developed for the construction and maintenance of stationary shelters. Under normal conditions, there is no crisis hazards [18], shelters are usually implemented that are necessary to form a specific protective infrastructure in the area of facilities selected for the critical infrastructure group and direct protection of the population. However, in virtually no European country, except Switzerland, full shelter is not provided in advance, in particular for direct protection of people. The missing part of the objects in question is planned to be made, among others, using shelters and to hide the ones built on the spot. In the case of Poland, only 4.4% of the population can be accommodated in existing shelters and so-called stationary hiding places [1]. The listed Polish stationary type hiding places are in fact shelters with the lowest immunity standard specified in the requirements [2, 21]. The presented paper characterizes the essence, types and tasks of hiding the temporary type. Selected possibilities and principles of solving concealments for civil protection and civil defense tasks were presented.

2 GENERAL CHARACTERISTICS

Systems and fortification facilities were constantly adapting to the challenges generated by means of firefighting, combat methods, and threats to the living environment and human activity [5, 14, 16]. Special changes and needs have already appeared in the early stages of using aviation as a combat tool. Aviation was used not only in operational tasks of the army but also to destroy targets deep in the territory of the attacked country. During the conflicts, mainly administrative centers, industrial centers, material stocks and residents of the country were attacked.

This threat has become even more important in the phase of the appearance of rocket weapons and mass destruction. The list of modern threats is also filled with conventional new-generation weapons of destruction, industrial, warehouse, transport, terrorist attacks and natural threats [17, 19]. Therefore, shelters and hiding places have become a necessity both on the battlefield and on the territory of the country. Modern fortification systems consist of individual shelters and hiding places scattered throughout the country according to specific defensive and protective tasks. According to the professional definition of fortification [11, 16], the shelter is a structurally closed structure, protecting people or certain property against assumed gross factors from all possible sides. A concealment is a construction that is structurally open, protecting people or certain property from assumed gross factors only from specific sides.

If it is impossible to make even temporary shelters, some protective solutions may be hidden. Concealments have limited general resistance, because they do not cover the interior to the same extent against the factors of destruction from every direction [15]. Hide tasks can be counted:

*Ccorresponding author: E-mail address: e-mail: zbigniew.szczesniak@wat.edu.pl, (Zbigniew SZCZEŚNIAK)

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1) protecting the population before temporary shelters or other protective projects are carried out,osłonę wykonawców w trakcie budowy schronów doraźnych lub wykonywania innych zadań operacyjnych,

2) cover for technical equipment or tools.

Stationary and temporary hiding can be distinguished. Examples of stationary hides are objects such as road tunnels, pedestrian crossings, typical building basements and other structures, which in the considered situation can be treated as bifunctional. Ad hoc solutions can be obtained as follows:

1) from handy elements and materials,

2) supported by prefabricated elements or assembled from such elements, preferably with a relatively low weight.

It is advisable to prepare emergency covers in the "weaker" directions of concealment and convenient access. There are solutions from various construction materials such as steel sheets, glued wood, composites, reinforced concrete and others. In the case of prefabricated solutions, the goal is to obtain the highest possible resistance with the lowest possible mass. The rule in the discussed solutions is the maximum use of natural protective properties of the soil, which is of significant economic importance.

It can be seen that ad-hoc expansion requires a certain space. It is important to choose the location of the ad hoc facilities in question. Ideally, these places should be free from particularly high concentrations of anticipated hazards. It is worth noting that in cities, the development of the sites in question with new residential and public buildings. This causes a continuous change of location conditions, which are important due to the degree of resistance of the given concealment.

Assumptions determining the concealment resistance and the full characteristics of the protective concept should be included in the appropriate classification formula. More information on the objects in question can be found in publications [3, 4, 6, 11, 12, 14, 16, 20]

3 EXAMPLES OF AD HOC HIDDING SOLUTIONS

Below are examples of temporary hide solutions that can be included in the planning of civil protection and civil defense tasks.

The Military Institute of Engineering Technology, together with the ALTER company, developed a lightweight folding shelter for military tasks in the field expansion of the fortification of the area (see [7]). The shelter construction elements are made of polyester-glass laminate with increased strength. Using the same elements, you can also construct objects referring to the idea of concealment. The concealment is manually assembled using connectors permanently attached to the joined elements. The sizes of the folding elements enable their transport without disturbing the road gauge. Assembly time for the concealed support structure, 5m long. forces of four people is about 1 hour. A general view of the structure of this concealment is shown in Figure 1.

The width of the hiding in the floor plane is 1.80m. The basic composite segment is 1 meter long. It is possible to combine segments into modules of any length. The shielding structure shown in Figure 1 is already a reliable concealment solution. Usefulness for assumed civil defense tasks as well as individual type assumptions will be obtained as a result of appropriate modification. For example, by using local soil, additional protective elements or materials and handy elements. It follows from the above that, if possible, concealments can be successively strengthened.

A scheme of another concealment solution is shown in Figure 2. The possibility of simultaneous use of new technologies with typical hand-held materials has been taken into account. The height of the backfilling Ho is selected according to the parameters of the assumed gross factors. Depending on the size of the space for development, temporary hiding can be placed as free-standing single objects or in groups of several or even a dozen or so objects. In the case of the discussed objects, it is natural to vary the concealment capacity and thus their length. In a special case, as a result of establishing an area free from assumed threats, for example from debris, one can obtain single-line or irregular spatial sequences. An example of the location of the considered shelters in the area is illustrated in Figure 3.

The covers, as already mentioned, have a structurally open housing. In this connection, it should be borne in mind that as a result we will obtain conditions of limited protection and therefore increased risk. This situation requires special attention when the task concerns the direct protection of people. It can be seen that hiding can support the task of centering people at a set time with certain threats. In special cases of environmental contamination, the time

Figure 1. Concealer supporting structure - general view [8]

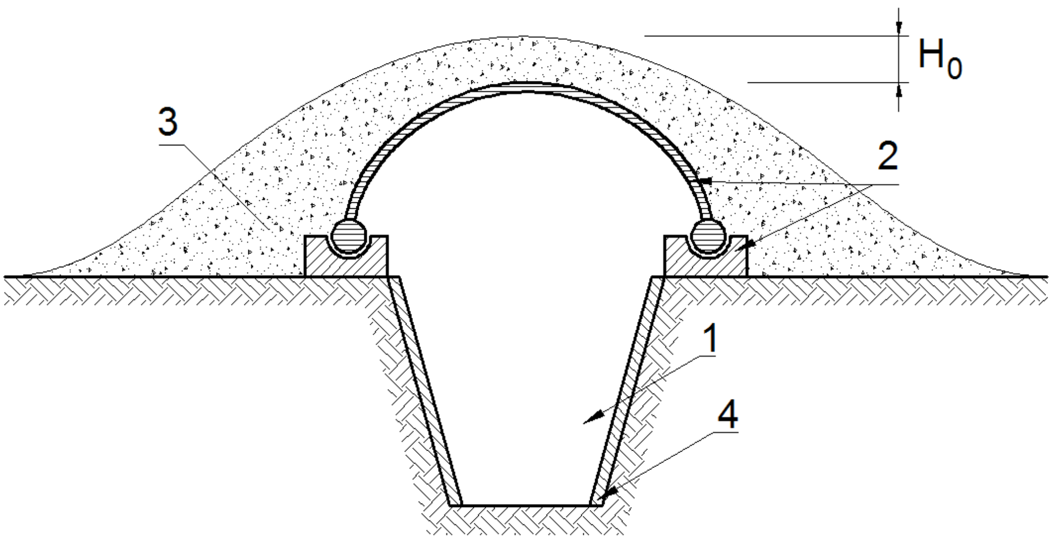

Figure 2. Example of concealment solution, 1-excavation or shooting ditch, 2-elements covering from laminates, 3-soil backfilling, Ho-minimum filling thickness, 4-covering excavation slopes from hand-held materials or laminates

spent in hiding should be kept to a minimum. In turn, it is possible to indicate situations in which the discussed residence time will not be subject to special restrictions.

Any time reserve should be used to reinforce the initial version of the concealment, starting with its "closing", as well as to collect additional materials and reinforcing elements and, if possible, equipment. It is advisable to rethink the rules of such work in the period preceding the time of danger. The need for appropriate documentation and organizational support is also evident.

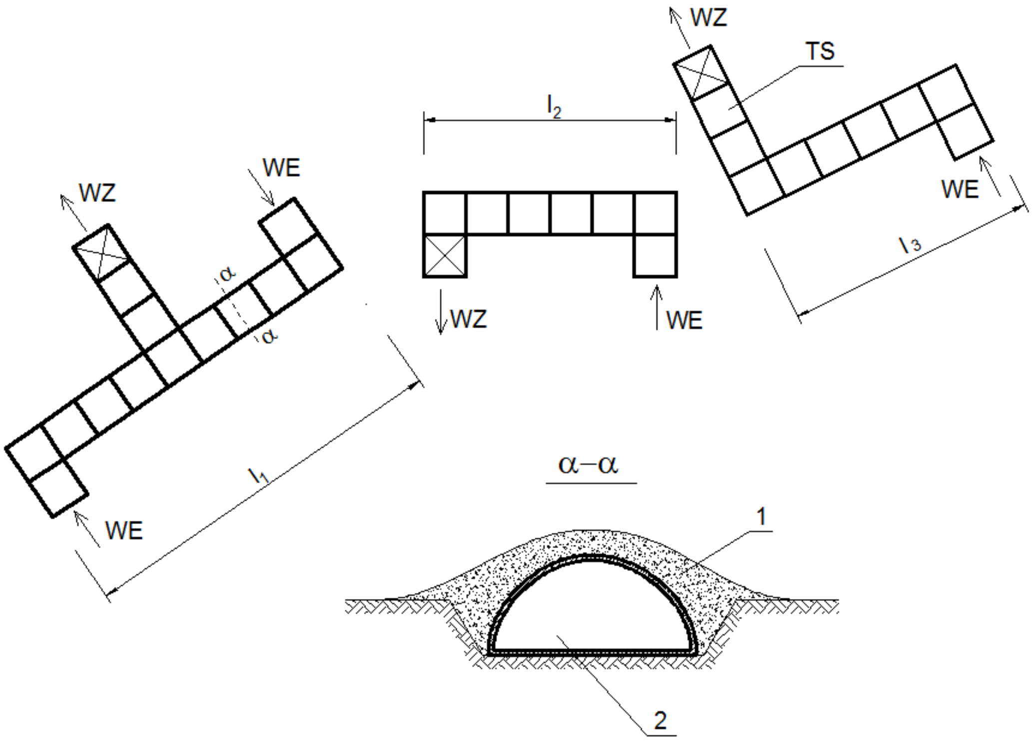

Figure 3. Diagram of possible location of temporary hides in the field, TS-typical module, l1, l2, l3- individual lengths of hide, WZ, WE-closing elements, 1-backfill, 2-cross-section of a typical module

4 BASIC IMPACT

4.1 Backfilling with debris

The rubble affects the underground part of the building that is subject to destruction as well as the neighboring buildings and structures, including the concealment.

The likely extent of the debris pile and its height are estimated mainly on the basis of research and observations from periods of past armed conflicts. Information in this regard can be found in the literature [19]. It can be noticed that Polish and German data coincide with the height of rubble Hg of frame and multi-storey buildings, then:

$$H_g \geq 0.25 H_b \tag{1}$$

where H_g is the height of the building.

Russian estimates of rubble height give smaller values. However, estimating the range of Lg rubble according to Polish formulas gives the best results:

$$L_g \geq 0.5 H_b + 3\,(m) \tag{2}$$

The intensity of the calculated static load from debris Δpr is determined depending on the number of storeys n of the above ground part of the building. In the case of buildings with reinforced concrete or steel framework, the load in question can be expressed by the formula:

$$\Delta p_r = 10kPa, for \quad n \leq 2, \tag{3}$$

$$\Delta p_r = [10 + 2.5(n-2)] \leq 25kPa, for \quad n > 2 \tag{4}$$

4.2 Strikes of objects and shards

In shelter construction for the protection of the population, it is considered to hit with heavy falling objects or structural elements separated during the destruction of the building. The depth of penetration of the falling element into the structural material of the shelter ceiling or the outer protective layer depends on the impact speed, shape and value of the cross-sectional area of the impact element and the deformation characteristics of the impact elements. The impact phenomenon, apart from the penetration effect, is also characterized by permanent changes in the structure of the material and the possibility of formation of fragments analogous to the case of contact charge explosion. In addition to the local-type effects mentioned above, the impact causes vibration of the entire element or structural system.

4.3 Protection against penetrating radiation

Below we present the rules for calculating protective layers only against residual radiation from radioactive fallout. Therefore, the basic tasks include determining the thickness of protective layers against the radiation in question. We will apply here the relationship between the weakened Do dose and the exposure dose of D radiation that penetrates the H material layer:

$$D_o = \frac{D}{10^{\frac{H}{d_{r10}}}} \tag{5}$$

where d_{r10} is a layer of 10-fold attenuation of residual radiation.d_{r10} layers can be taken:

- for concrete - 0.20 m,
- for soil - 0.30 m,
- for bricks - 0.25 m,
- for wood - 0.80 m,
- for steel - 0.06 m.

The above formula shows the dependence on the thickness of the protective layer depending on the fold weakness of radiation K_r :

$$H = d_{r10} \quad lgK_r \tag{6}$$

In the case of layered protective partitions, after taking into account the physics of suppression of residual radiation from (3.1) we get:

$$\sum_{i=1}^{i=m} h_i \rho_i \geq \rho_1 d_{r10(1)} lgK_r \tag{7}$$

where:

h_1 ... h_m - thickness of individual layers [m],

ρ_1 ... ρ_m - material density [kg/m^3].

The radiation attenuation fold should be at least 100 times.

To protect the entrances and openings against radiation, it is recommended to use the effect of the refraction of the radiation path. One refraction at an angle of 90 degrees corresponds to a decrease in radiation of K 10 times.

5 CONCLUSIONS

The paper characterizes the basic tasks in the area of fortification expansion for the protection of the population and civil defense. The main attention was devoted to extending the ad hoc using s and hide ad hoc type. Ad-hoc expansion is an important undertaking in a situation where it is impossible to prepare a set of shelters in advance to support the tasks of civil protection and civil defense.

The possibility of using solutions based on new construction materials of the composite type was taken into account.

New composite materials give the opportunity to achieve much better thermal and corrosion resistance compared to already standard materials of this type. Requirements for bullet and fragment-resistant products ([10]) are met. The materials in question in specific applications allow the product to be reduced by approximately 37% compared to aluminum and by 48% compared to steel.

It can also be seen that, in the situation under consideration, the existence of production plants that have the technologies in question is of great importance.

The development of the presented concepts is conditioned by the existence of such a system of civil protection and civil defense in which the supportive role of modern fortification solutions is appreciated. A good example is the latest doctrinal approach of the NATO Treaty ([7, 15]). The problem of fortification extension was there as a priority under the program called "force protection engineering".

Although the presented considerations relate to ad hoc actions, it is important to perform pre-emptive analyzes in the scope of planning the location of the discussed objects and identification of soil and water conditions. The problem is important because in large cities there is still development of free areas, which are important from the point of view of civil defense tasks.

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