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THE BUILDINGS PROVIDING THE STAFF'S PROTECTION SYSTEMATIZED EARLY IN THE HUNGARIAN ARMY

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ABSTRACT

Over the past half a century, there has been tremendous progress in both destruction devices and materials and devices that provide protection against them. Of course, as a consequence, the wars and methods have changed a lot. In this article, I analyze and systematize the structures used to protect the personnel previously employed in the Hungarian Defense Forces in order to draw conclusions on their further applicability and possibilities for modernization.

KEYWORDS: destruction devices, warships, protection of personnel, constructions

1. Introduction

By using the covers and shelters arranged in the Hungarian Defense Forces, the previous instructions were published in the early 1960s. In these instructions, in the 20th century, mass armies were characterized by their technical standards and regulated the ways and tasks of building structures to protect the personnel. Over the past half of the century, there has been a tremendous progress in both destruction devices and materials and devices that provide protection against them. Of course, as a consequence, combat techniques and methods have changed a lot. In this article I analyze and systemize the constructions used to protect the personnel of the Hungarian Defense Forces for the reason to draw conclusions on their further applicability or the possibility of modernizing them.

In the posts and placement areas, shelter covering (ditch coverings), trench-type coverings and shelters have been built for the protection of the personnel. These constructions provided the personnel protection from the effects of destruction devices and weather, and allowed work and rest.

Protective structures of personnel were placed in posts, bases and defense areas – usually attached to the pits connected with the fox-holes and communication trenches – in various areas near the combat equipment and the personnel's location. Entrances to the defense structures must be constructed on the opposite side of the enemy shooting range.

When selecting the location of the slits, shelters and covers, the deeper sections of the terrain must be avoided to reduce the effects of surface water and to avoid and reduce the effects of toxic and biological warfare.

2. Silt Trenches, Ditch Covers

Silt trenches and ditch covers are the simplest types of structures for the protection of the personnel (Figure no. 1). Nonetheless, they provide adequate protection against the enemy fire, the repercussion of artillery bullets and bombs, and also reduce the impact of weapons of mass destruction.

Slit trenches, in the trench-system, for the rifle squad must be connected to the fire trenches under the front parapet, and for the crew operating the artillery and tanks,

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trenches must be installed with connection to the emplacement. For sub-units in temporary areas or serving sub-units, shelters must be constructed as a stand-alone building.

Depending on the number of crew or the number of the mechanized rifle squad, silt trenches should be built to a depth of 1.7 meter at a length of 2.5 to 3.6 meters. Its width should be less than 0.6 meters and the top must be 1.2 to 1.4 meters depending on the stability of the soil. The slab should be made of logs, dongs, beams, arched sandbags or of any materials needed. The slab structure must be covered with a 60-centimeter-thick layer of soil, and must be camouflaged. Depending on the location, the length of the entrance part is 3.0 to 4.0 meters, which also must be covered.

In the case of loose, crumbly soils, the sidewalls must be covered to prevent collapse.

Trench cover is one of the simplest structures. They can be constructed relatively quickly and in terms of their structure and the amount of materials needed to build them. They provide adequate protection against the enemy's fire and therefore play a significant role in the future of fortification.

Advantages: It can be built in a relatively short period of time, and after the construction has started, it proved some level of protection (open slit trench). Its construction does not require the use of large amounts of building materials; it can be created from local (necessary) materials.

Disadvantages: Stability is highly dependent on soil quality. It only partially protects against the effects of chemical and bacterial attacks, and it partially protects the personnel form weather conditions. The personnel in the construction must use their personal protective equipment (gas mask, combat gear and protection kit).

Recommendation: Since their structure and construction are simple – they no dot require special expertise – and practical experience also shows they provide effective protection for personnel during peacekeeping operations, so they must be maintained in the Hungarian Defense Forces.

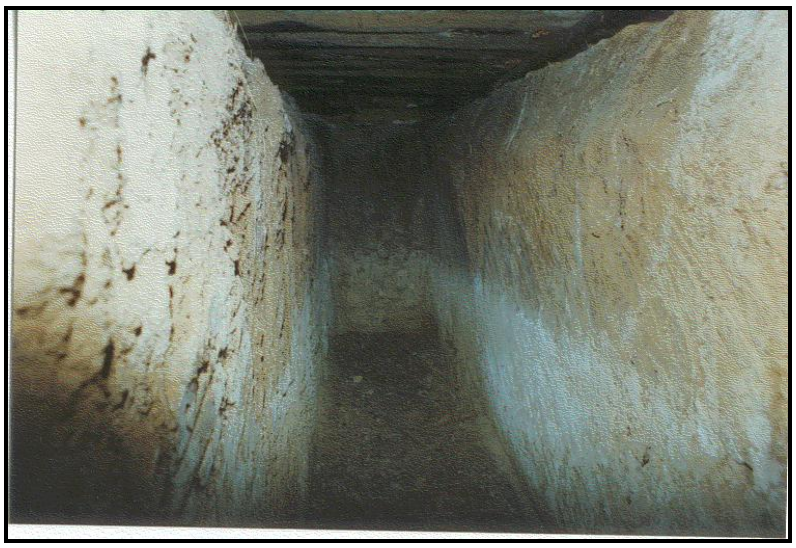

Figure no. 1: *Mainroom of covered trench*

3. Covers under the Parapet

The fortification equipment of posts, guards and other areas usually require the construction of a cover under the parapet for the squads (or operating personnel). Depending on the materials available, they may be made of thinner logs, studs, leftover materials, sandbags or other casings

(NETLON mesh) such as corrugated board elements or other building materials.

The purpose of cover under the parapet is to ensure the personnel's alternating resting time and to enhance the protection against the enemy's destructive weapons and weather.

They provide protection against the firearm projectiles, artillery projectiles, shrapnel of bombs, direct hits of grenade-mines and against the effects of chemical, bacteriological, biological and radioactive materials if the personnel residing the building uses its protective equipment. These structures can be classified as a "Class V." according to their degree of protection ($P = 10^5$ Pa).

Coverings are built for the personal staff of mechanized shooters, tankers, artillery and other subunits, accommodating 4 to 8 people (4 to 6 people in reclining position and 2 in a sitting position). The entrance to the cover must be provided with a protective door. Pre-entrance trenches (communication trench) must be covered with at least 14 centimeters long studs with a 0.8-meter-thick soil cover, at a length of 2.5 to 3 meters.

In loose soils, if sufficient time and material is available, the slopes of the trenches (communication trenches) must be covered with materials at least 2 meters before the entrance of the cover.

Beds and benches must be installed for resting in the cover. An army-accepted stove (or made of necessities) in winter must be set. Personnel must use their anti-chemical and radioactive protection equipment in the cover. The lighting under the parapet is covered with kerosene lamps, flashlights and other lighting devices. In order to ventilate the building, a ventilation boy should be made using wood, the opening should be fitted with a protective device to prevent the penetration of air waves.

The "LAZ" (LAZ = radiation-proof hermetic entrance. Modern requirements, reduced time to build fortified structures, quick and easy handling, easy delivery and quick installation, but also improved personnel protection against radiation had made it necessary to create a LAZ-type entrance. The use of the LAZ-type entrance allows faster preparation of the shelter made of the materials needed, ensuring the hermetic closure of the entrance) hermetic entrance can be used as an entrance part. For the installation of the LAZ-type entrance part, the entrance end of the building is closed with at least ø15 cm spherical trees. In the center of the front wall, a hole of the following size shall be provided for proper connection of the LAZ-type entrance:

- Circular shape: 80-90 cm in diameter;
- Square shape: 90 cm in size.

The lower part of the gap needs to be closed with three 12 cm studs, and the remaining part with the LAZ-type entry elements. For installation, a 45° slope should be provided.

Under the instructions given by the Hungarian Defense Forces, the cover under the parapet is installed at the section point. Extremely large wood requirement (for 1 building 2-3 m^3 of round wood is needed) should be counted in the construction of these structures. There are few forests in the territory of Hungary, therefore the use of wood in bulk is not allowed. Instead of woodless and corrugated sheet structures, we need to look for more modern materials and their applications. We still need to be familiar with the methods of construction, and we need to further educate them.

3.1. Cover under the Uncoated Parapet

The non-tenoned wooden parapet should be made of ø 15-20 cm round wood. The round wood join without flattening, leaning on the ends of the columns and the lower casing, and the slabs lie on the columns.

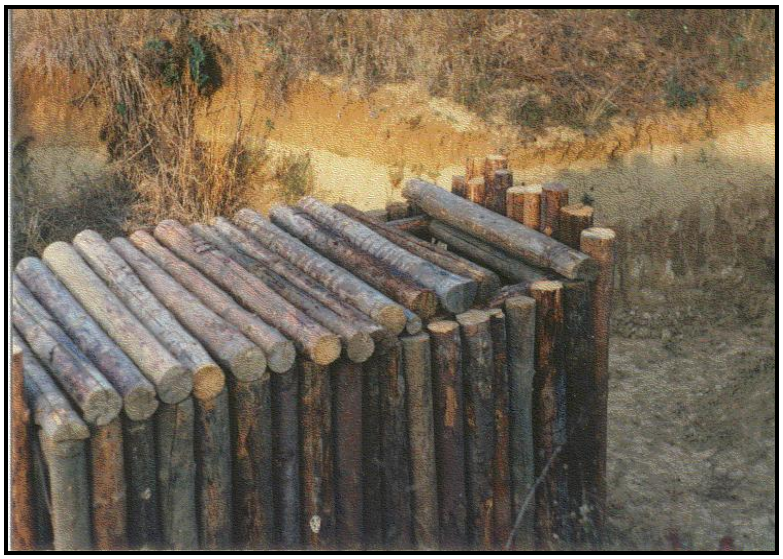

Figure no. 2: *Non-tennoned cover under the parapet*

To support the columns, longitudinal support beams must be installed to support the column pressure, which should be supported by stanchions 50-60 cm apart. On the foundation of the stanchions, the support beams must be folded down. The support beams and stanchions must be secured to the slabs by wires and nails.

The front wall must be constructed of vertically places roundwood. In the entrance part, a door block with three support frames must be installed. The gaps between the support frames and the joints of the entrance part must be carefully sealed with tow or rags and the layer above the entrance must be layered with 30 cm thick.

The construction of the cover under the non-tenoned parapet does not require woodworking expertise; it is well suited for the protection and resting of personnel at squad and division level. A major disadvantage, however, is the need for large amounts of earthwork and the roundwood requirement of nearly 3 m^3 for the construction.

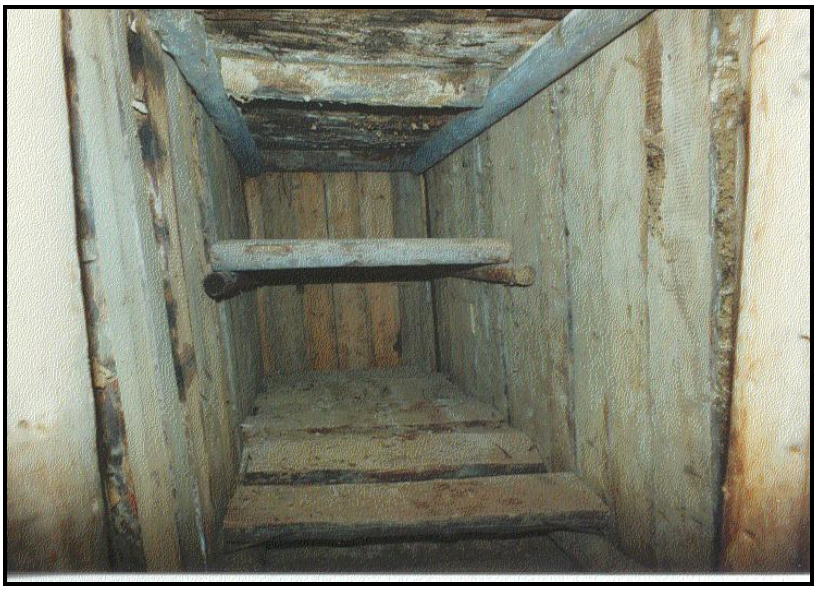

Figure no. 3: *Interior plan of the non-tennoned cover under the parapet*

Advantage: Provides adequate (but not collective) protection against the effects of destructive devices (explosions, splinters and shrapnel) and weather. The assembly does not require construction or woodworking skills.

Disadvantage: There is a significant demand for timber (3-4 m^3/cover). A large amount of earthwork (25 m^3) is required to install the cover. Stock storage and transportation require significant capacity. Protection against wood pests must be considered.

Recommendation: Due to the high timber requirement of non-tenoned covers and installation time (90 workers/hr), it is no longer meets the new challenges and expectations, but it is expedient to use it as a final solution.

3.2. Cover under the Corrugated Sheeting

The cover under the parapet made of FVSZ-type (FVSZ = Fortifikacionnaja Volnyisztaja Sztal (in Russian) trans. fortification steel corrugated sheet.) corrugated sheets with the capacity of 8 is rounded. When assembled from FVSZ-type sheets, the sheets must be connected is pairs, arched, and the sheets are placed on top of each other continuously along the length of the building.

Figure no. 4: *Corrugated sheet cover under the parapet*

At the bottom, the FVSZ sheets rely on longitudinal sub-frames, which are made of perforated roundwood and are fixed with spikes or nails. To accommodate the side pressure, spacers must be placed between the underlays, which are fixed with carpentry clips. The end wall of the building must be sealed with a shield made of at least ø 15 cm of roundwood. The entrance part must be constructed as described in the cover under the uncoated parapet.

The great advantage of the cover made out of corrugated sheets is that is does not require large amounts of roundwood, or that the main room can be assembled relatively quickly in addition to the need for earthwork. The corrugated sheet structure is stronger and provides more protection for the personnel in the structure. The disadvantage of the construction os that the interior of the main room is relatively small and the metal structure painted on green reduces the comfort feeling.

By increasing the size of the main room and creating an interior painting the enhances the degree of comfort, the building is suitable for replacing the cover under high wood and working hours with no need for woodwork.

Advantage: The storage of FVSZ sheets produced in the industry can be solved in the peace-guards of the units. The construction time of the main room, thus the entire building, is significantly reduced by the use of corrugated sheets. 1.8 m^3 of roundwood is required for the construction of the cover, which is significantly less than for the uncoated cover under the parapet.

Disadvantage: The cover does not have devices for collective protection. The transportation of the materials entails considerable capacity from the location of the peace-guard to the place of installation. The weight of corrugated sheets (1 set of 140 kg) makes the building material of the cover a significant physical strain.

Recommendation: Steel corrugated sheets, which are currently in the system and represent the level of the fifties, can be upgraded with effort and equipment and kept in the system up until the acquisition of new equipment in the Hungarian Defense Forces.

4. Shelters

One type of fortification building that enhances the protection of personnel and civilian populations during combat activities, and provides protection against the enemy's destruction devices and the weather. Based on their purpose, we can distinguish between shelter for work, rest, health care and special purposes. They differ in size and in their interior. They can be light and heavy in their ability to protect. The lightweight shelter protects against the direct hit of medium artillery shells, with chemical and bacteriological contamination, and against the effects of inflammable weapons. Heavy type shelters also provide protection against heavy artillery shells. According to their method of construction, they distinguish above-ground, partly embedded, embedded and underground shelters. The shelter can be built form on-site materials pre-produced wood, metal, reinforced concrete, plastic, textiles etc. elements. Shelters are provided with airtight doors, anteroom, filter-ventilation equipment, and a stove. Their interior equipment is designed according to their purpose (bed, sitting-, working equipment, etc.) Shelters should be located in the field so that the personnel can occupy and leave quickly and preferably unseen.

Taking into account the technical condition of the regular shelters, the overdue technical standards they represent, the maintenance difficulties and the survival of the personnel, their withdrawal from the system is definitely warranted, in parallel with the provision of new types of shelters.

4.1. Lightweight, Non-Tenoned Shelter

The non-tenoned shelters should be made of 15-20 cm roundwood. At the joints, the parts must be connected without tenon in a similar manner to non-tenoned covers under the parapet.

The entrance to the shelter must be fitted with a hermetically sealed protective door. It is necessary to separate the foreground (sluice) from the main room of the shelter with a wall in which there is a hermetically sealed door made of boards.

The structure of the entrance part allows the installation of a closed airtight BD-50 type door block and an OHSZ-100 type filer-ventilation unit.

The door block must fit tightly into the entrance part frame. After the door block has been set, it must be secured with four carpentry clips, which must be lowered at the top and bottom, on the right and left of the entrance, into the frame of the front wedge.

In order to prevent the air supply of the building from contamination, and in order to purge the intake air from toxic a radiating particles, a filter-ventilation device must be installed. To protect the air collection tube (trachea) of the filter-ventilation unit, a protective cover should be made of planks, rods and roundwood. A VZU-type (VZU = Vozduho Zastitnoe Usztrojsztvo (in Russian) trans. air stroke control valve) anti-shock valve must be fitted to the upper edge of the sheathing.

A stove that is pre-installed or made out of necessities for heating in the building must be used. The stove should be positioned so that is as the location of the highest temperature drop, usually near the door. At the end of the exhaust pipe, a DZU-type (DZU = Dimo Zasitnoe Usztrojsztvo (in Russian) trans. anti-shock valve mounted at the end of the exhaust pipe.) anti-shock valve must be fitted so that the surge wave created by the overpressure on the surface does not get inside the structure.

The non-tenoned light type shelter provides adequate collective protection against varius destructive devices. The structure in World War II was used in masses where nearly 6-8 m^3 of roundwood was available.

Advantage: The structure of the shelter as well as its interior equipment ensures the collective protection of the personnel in it against the effects of destruction devices. Installation does not require construction – or woodworking skills.

Disadvantage: There is a significant demand for timber (6-8 m^3/cover). A large amount of earthwork (120 m^3) is required to install the cover. Stock storage and transportation require significant capacity. Wood pest should be taken into consideration as well.

Recommendation: Due to the high timber demand and significant installation time of the non-tenoned shelter, the new requirements no longer meet the old ones, but it is expedient to use it as a solution in areas where significant wood supplies are available.

4.2. Continuous Frame-Type Lightweight Shelter

The lightweight, easy-to-use shelter for up to 30 people consists of the main room, the entrance and the emergency exit.

Tables and chairs in the main room of the shelter (30 m^2) provide place to work for 10 people and the built-in wooden benches provide seats for 32 people (or sleeping place for 8 people).

Based on the calculations carried out, the structure provides protection for the personnel in the immediate hit of a 250 kg air bomb. The building can only be installed at groundwater level between 9 and 10 meters (or deeper) from the ground level.

It is advisable to construct a shelter on a slightly sloping hillside with a longitudinal arrangement perpendicular to the slope of the hill. On a slope of less than 30°, the entrance to the shelter must be made sloping and a vertical shaft for the emergency exit must be installed.

The main room should be made of shield-frame elements. The ends of the elements used for the casing must be flattened to one third of the diameter and the elements joined together as shields. Attaching supporting boards and braces to the inside of the shields is needed.

A drainage ditch should be built 5 to 10 meters above the foreground opening to the hillside (depth 40 cm, width 20-40 cm). The water in the ditch must be taken away from the structure on the natural slope of the terrain, into a water wash or valley. Waterproof material (tar paper) must be placed in two to three layers on the 10-30 cm leveling soil layer above the slab for the waterproofing of the floor of the underground structure.

The structure and construction method of the building is more advanced due to the design of the shields, but it still requires a lot of roundwood. In the event that the building is embedded in the soil for a prolonged period of time, care must be taken to protect the wood from various fungi and pests.

Advantage: Due to the shield structure, the shelter provides the possibility of prefabrication of the building materials and simpler and faster construction. The structure of the shelter as well as its interior equipments ensures the collective protection of the personnel in it against the effect of destruction devices.

Disadvantage: The installation of the shield structure requires specialization and

tools during the construction and woodworking. There is a need for significant amount of timber (6-8 m^3/cover). A large amount of earthwork (120 m^3) is required to install the shelter. Stock storage and transportation require significant capacity. Protection against different types of wood pest should not be forgotten.

Recommendation: Due to the large demand for timber and significant installation time of the shelter, the new requirements are no longer met, but it is expedient to us as a solution in areas where a large supply of wood is available.

4.3. Lightweight Shelter (LKSZ Shelter Kit)

The LKSZ (LKSZ = Ljogkoe Karkasznoe Szoruzsenyije (Russian) trans. lightweight skeleton structure) lightweight shelter at the control points of the units (subunits) serves to ensure the work, rest and protection of the personnel. The shelter provides protection against shock waves of explosions, chemical, bacterial attacks, and weather conditions.

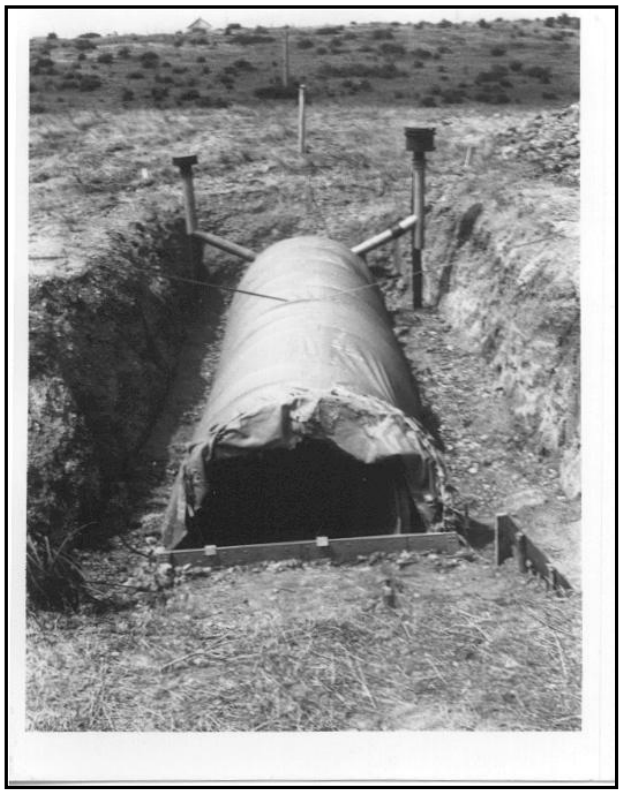

Figure no. 5: *LKSZ shelter*

The space of the LKSZ shelter is divided into a foreground and interior. The interior can be accessed through an airtight door. The load-bearing structure of the shelter consists of aluminum support rings and a loose-fitting canvas cover. For the supporting rings, the cover is secured with binding straps. The bracing of the shelter is done with cables. The two-third of the interior space and the foreground are covered with earth from the outside, the not free-standing part serves as an entrance which is covered by a casing fixed to the folding-frame. A ladder can be attached to the entrance-part for the purpose of facilitating and making traffic easier. The interior equipment ensures ventilation, heating, work and rest. Electric lighting, telephone and radio can be installed and placed in the building.

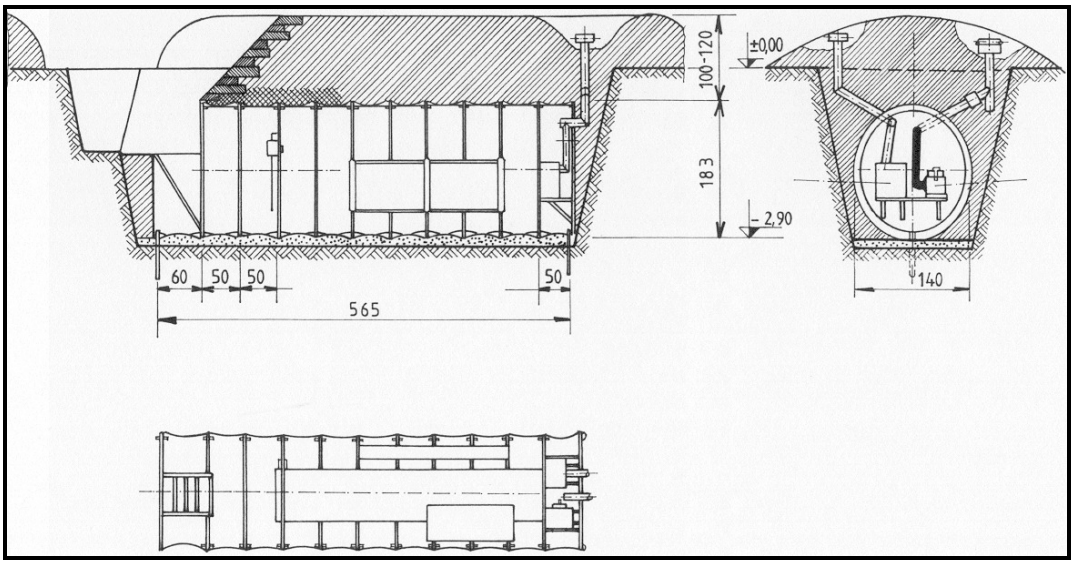

Figure no. 6: *LKSZ shelter*

The main tactical and technical data of the LKSZ shelter:
Main Dimensions:

Width: ..... 1.4 m;
Height: ..... 1.8 m;
Length of interior: ..... 4.0 m;
Length of foreground: ..... 1.75 m;
Overall length: ..... 5.75 m;
Internal air volume: ..... 7.9 m^3;
Mass: ..... 540 kg;

Other data:

Protective power: ..... 10^5 Pa;
Number of people to accommodate: .....4 to 6 people;
Volume of base pit: .....30 m^3;
Installation time without earthwork
7 people: .....15 minutes;
Available on 1 truck: .....6 sets.

Advantage: The shelter is and industrially manufactured and stocked unit, so storing and transporting it with the right capacity is easy. Assembling the LKSZ shelter is the simplest task of all types of shelters. For a well-trained section, assembly takes 15-20 minutes.

Disadvantage: In addition to carrying out a relatively large amount of earthwork, skilled soldiers are needed to build the structure. A major disadvantage of the construction is that in the space between the rings the loose soil creates a sense of danger, and fungus and mold appear in the material of the structure after a long period of time. Well-trained and practiced personnel are needed to build an LKSZ shelter. The structure is relatively complicated, violating its construction method may lead to decreased stability and strength and thus its ability to protect.

Recommendation: There are currently 27 sets of shelters in various incurring warehouses, mainly because they have not been included in the file tables. The withdrawal from the Hungarian Defense Forces has taken place.

4.4. Corrugated Sheet Shelter (KVSZ – U Shelter kit)

The purpose of the shelter is to protect the personnel and ensure the work of the high-ranked units (KVSZ–U = Konstrukcija iz Volnyisztoj Sztali-Ubezsise. Translation from Russian: Shelter from steel corrugated sheet structure). The material used for the shelter is corrugated and staved steel sheets which can be bolted together to make a circle-sectioned structure. Its structure is simple so its assembling and building skills can be mastered in a short time. Its great advantage is that it can be used several times, easily transported and installed with both manual and machine power.

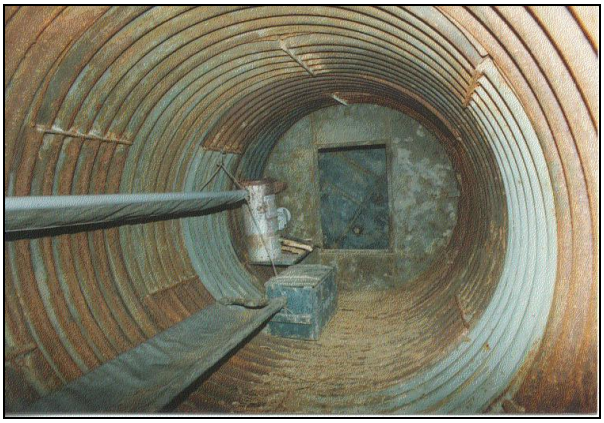

Figure no. 7: *Interior of KVSZ–U shelter*

Main tactical and technical data of KVSZ – U shelter:

Main Dimensions:

Main room interior length: ..... 5.50 m;
Main room interior diameter: ..... 1.86 m;
Total weight: ..... 1500 kg;

Other data:

Protective capability: ..... $2 \cdot 10^5$ Pa;
Number of people to accommodate: ..... 6-8 people;
Installation time;
7 people + 1 bulldozer: .....6 hours;
Available on 1 truck: ..... 2sets.

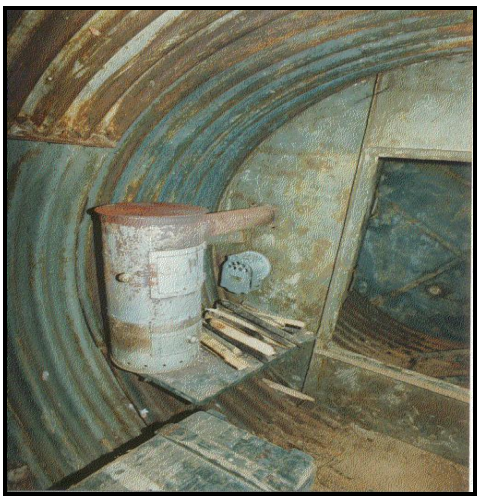

Figure no. 8: *KVSZ – U heating system solution and overpressure control valve*

My experiments at the Csobánka Central Tactical Training Ground proved that the construction of the structure is extremely simple, as the personnel involved in its construction could have completed the individual steps independently after assembling the first one or two rings. Disadvantage of the construction is that the hatch opening is relatively narrow and entering the construction is difficult because of the 300° gradient. The advantage of the construction is that it is possible to install it even at relatively high groundwater levels.

Advantage: The corrugated and staved sheet shelter is and industrially manufactured and stocked structure. The KVSZ – U shelter can be assembled and dismantled several times, easily transported and installed by hand and by machine. The dimensioned structure can withstand the overpressure of $P = 2x10^5$ Pa if the internal equipment is operated properly. The structure also provides the opportunity for installation in case of high groundwater level or reduction of the time required for installation.

Disadvantage: The shelter kit has significant transport capacities. There is a need for trained practiced personnel to build the structure. The rebuilding of the structure is difficult, with the use of machines, the corrugated sheet may be damaged and are vulnerable.

Recommendation: Corrugated steel sheet shelters representing the quality of the fifties. The withdrawal from the Hungarian Defense Forces has taken place.

4.5. Corrugated Sheet Shelter (KVSZ – A Shelter Set)

The KVSZ-A type shelter (KVSZ–A = Constriction Volnytistoj Stali Armii (Russian language) trans. Army Commander Shelter with steel corrugated sheet structure) is used to ensure the work, rest and protection of personnel (and high-ranked units) at the action stations. The shelter protects against shock waves of explosions, chemical and bacteriological attacks and weather conditions. KVSZ – A is an upgraded version of the former KVSZ – U shelter.

Its modernity is manifested in:

- KVSZ – A elements of the shelter can be installed both externally and internally, so that an embedded and underground structure can be formed;
- Instead of a vertical hatch opening (in the case of KVSZ – U) a horizontal entrance ensures traffic;
- KVSZ – A shelter length and diameter is larger than of the KVSZ – U type;
- Corrosion protection of the elements is more effective.

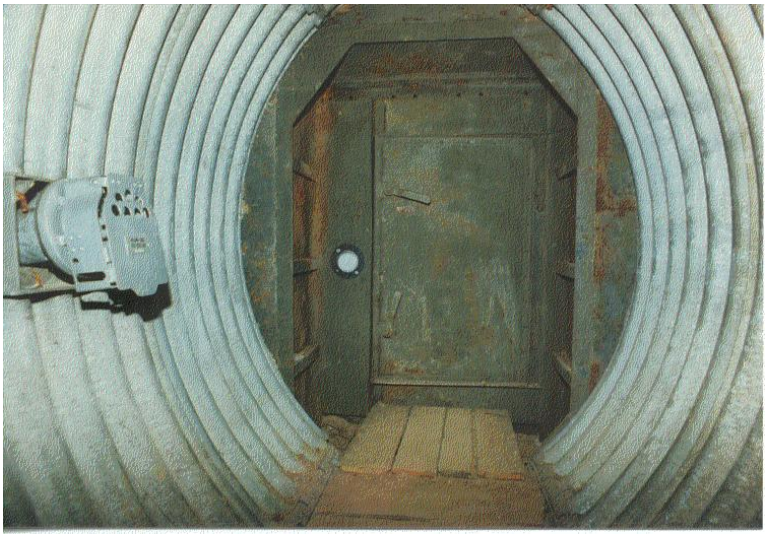

Figure no. 9: *Entrance part of the KVSZ-A shelter*

The material used for building a KVSZ – A shelter is corrugated and staved steel sheets. The kit contains large and small elements and elements with holes, as well as partition and end-wall elements. By assembling four large sheets a ring can be built, and by installing these ring side by side, the main room can be formed.

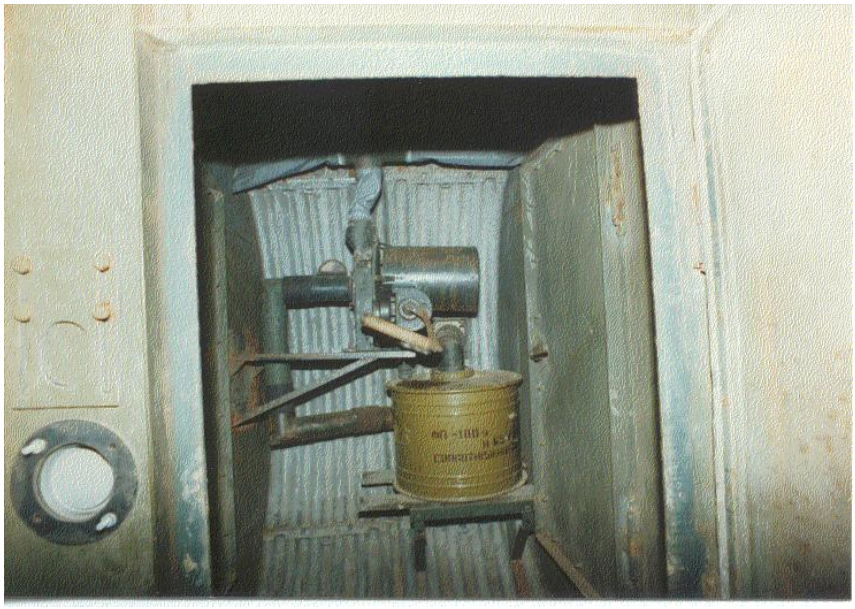

Figure no. 10: *KVSZ- A Filter-ventilation equipment for the shelter*

The entrance part has an ellipsis cross section, the rings of which can be assembled form two large and two small sheet elements.

The main room can be divided, with two soundproofing partition, into a foreground and two work-areas. Workspaces include table, chair, bed, stove and seats.

In the foreground, an OHSZ – 100 or OHSZ – 100M -1 filter-ventilation system is placed (manual or motorized). Holes are provided in the steel sheet for air and smoke pipes.

The headwall of the main room is bounded by end-plates which are provided with a door so they can also be used as intermediate end elements.

The main room is connected to the entrance by the transition element.

The entrance part is divided into a closed and open entrance part by a protective separating-wall.

The large and small parts, as well as the transition elements must be secured to each other by screws. The end-wall is connected to the main room; the transition element to the closed entrance part, the closed and open entrance part is connected to the protective wall, these are fixed in place by the ground's pressure.

There are several KVSZ – A kits that can be used to create a protective facility.

The KVSZ – A shelter can be assembled with the KVSZ - U shelter, with the help of the KVSZ – U and KVSZ – A gateway element.

KVSZ – A main tactical and technical data of the shelter:

Main Dimensions:

Main room interior length: ..... 7.68 m;
– of which length of foreground: ..... 1.20 m;
Main room interior diameter: 2.18m;
Length of open entrance:..... 1.20 m;
Length of closed entrance: ..... 1.20 m;

Inside height of entrance parts: ..... 1.85 m;
Inside width of entrance parts: ..... 1.35 m;
Total weight: ..... 4000 kg;

Other data:

Protective capability: ..... 2 x 10^5 Pa;
Number of people to accommodate: ..... 6-8 people;
Volume of base pit: ..... 50 m^3;
Installation time;
7 people + 1 bulldozer: .....7 hours;
Available on 1 truck: ..... 1 set.

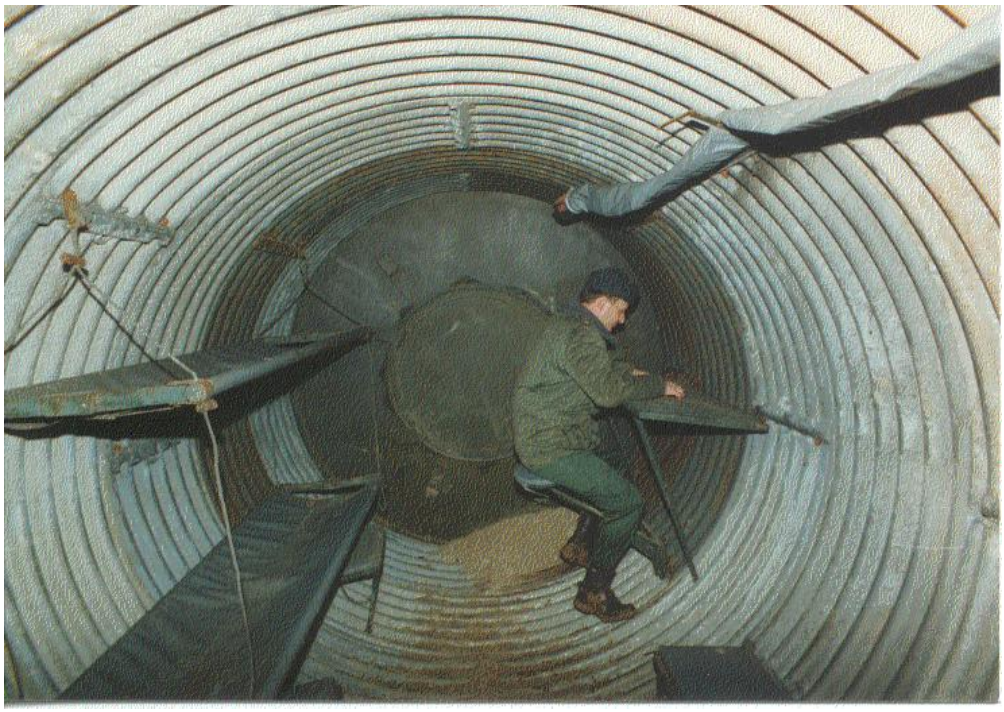

Figure no. 11: *Interior of KVSZ – A shelter*

Advantage: The corrugated and staved steel sheet is and industrially manufactured and stocked structure. The building is packed in kit-frame which facilitates transporting. The corrosion protection of the corrugated sheets forming the building's premises is secured by galvanizing. The KVSZ – A shelter provides collective protection against various destruction devices for the personnel in it. The dimensioned structure can withstand the overpressure of P = 2 x 10^5 Pa of the internal equipment is operated properly. The interior dimensions and equipments of the building provide a greater comfort for the personnel in it.

Disadvantage: The shelter kit has significant transport capacities. There is a need for trained and practiced personnel to build the structure. Large elements of the shelter can only be loaded from the kit-frame to its destination using a crane. The rebuilding of the structure is difficult, with the use of machine tools, the corrugated sheets are vulnerable.

Recommendation: Corrugated steel shelters that are currently representing the quality of the fifties. The withdrawal from the Hungarian Defense Forces has taken place.

Table no. 1

The main parameters of the structures at the Hungarian Defense Forces

No.	Name	Size (cm)	Capacity (person)	Protective Ability (Pa)
1.	FÓÁ	450 ·60 ·150	3–4	–
2.	FN MAF	350 ·180 ·120	4–8	$P = 10^5$
3.	HL MAF	390 ·186 ·155	4–8	$P = 10^5$
4.	FN KOH	595 ·180 ·120	10–20	$P = 10^5$
5.	Continuous frame structure	1020 ·180 ·180	10–30	$P = 10^5$
6.	LKSZ	565 ·183 ·140	4–6	$P = 10^5$
7.	KVSZ–U	550 ·186	4–6	$P = 2 \times 10^5$
8.	KVSZ–A	802,6 ·232,0	6–8	$P = 2 \times 10^5$

5. As a Closing Word

Based on the analyses and evaluations carried out the following conclusions can be drawn:

1. Most of the fortification structures previously used in the Hungarian Defense Forces to ensure the protection of personnel are outdated, in its current form do not meet the requirements of modern combined arms combat and operation, so their withdrawal from the system has become a timely task.

In detail:

- Open-type fortification structures for the protection of the personnel – shelters, ditches – and their easy and quick deployment, besides their minimal material requirements, significantly increase the protection (survival) of the personnel against the enemy's destruction devices, and thus play a decisive role in the field of fortification in the coming times;
- Non-wooded and shielded coverings and shelters do not meet the new requirements due to their high wood requirements, significant installation time, but it is expedient to use them as a solution for necessity;
- Corrugated steel sheet and lightweight coverings and shelters representing the quality of the fifties can be upgraded with effort and equipment until the purchase of new ones;
- The internal equipment (lighting, filer-ventilation equipment, heating) of the buildings providing collective protection is outdated, and their replacement is justified.

2. It has become a timely task to reconsider the principles of fortification, including the construction of structures for the protection of the personnel, starting from the requirements of modern combined arms combat and operations.

3. When designing and constructing structures, more care should be taken to use pre-fabricated components (e.g.: fortification foam, fortification shroud, mobile fortification elements, HESCO bastion, explosives, etc.) that accelerate their construction, allowing re-usage and increasing protection of the personnel in it.

4. In addition to the above principles, increased care should be taken to maximize the potential of the home area to replace earthwork and wood usage.

REFERENCES

Ananics, S. A., Buznyik, P. K., & Szuharev, A. I. (1984). *Fortifikácia*. Moscow: Voennoe Izdatyelsztvo, ¹3/89735.

Horváth, T. (2000). *Possibilities of Increasing Protectiveness in Fortification-Camouflage*. Budapest: Miklós Zrínyi National Defense University.

Horváth, T. (2002). *Investigation of the development of fortification structures for the protection of personnel and possible directions for further development.* PhD dissertation, Budapest: Miklós Zrínyi National Defense University.

Horváth, T. (2018). Войсковые фортификационные сооружения для пунктов управления. *Military Engineer, Vol. XIII, No. 3*, Budapest: National University of Public Service.

Horváth, T., & Wanczel, G. (1995). *Fortification*. Szentendre: Kossuth Lajos Military College.

Horváth, T., & Wanczel, G. (1996). Fortification model garden in Csobánka. *Technical Military Bulletin, 6 (1)*, 51-54.

Horváth, T., & Padányi, J. (2006). Techniques for peace support operations and possibilities for development – Part I. *Military Logistics 14 (4)*, 96-130.

Horváth, T., & Padányi, J. (2007). Technical tools for peace-support operations and opportunities for development – Part II. *Military Logistics15 (1)*, 68-86.

Padányi, J., & Horváth, T. (2001). *Úkoly zenistu pri budováni ochrannych staveb a provádeni stavební cinnosti v mirovych silách.* Sbornik Vojenské Akademie v Brne Rada B: Technicke a Prirodni Vedy 1, 103-110.

Варенышев, Б. В., Дубинин, К. Н., & Мудрагей, И. П. (1982). *Военно-инженерная подготовка*. Воениздат.

Колибернов, Е. С., Корнев, В. И., & Сосков, А. А. (1984). *Инженерное обеспечение боя*. Воениздат.