

APPLICATION OF MOBILE SHELTERS IN PERFORMING TASKS OF TECHNICAL PROTECTION OF USTS FACILITIES

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Problem Statement. In the context of full-scale armed aggression against Ukraine, there is a significant transformation in the nature of threats to the civilian population, manifested in the predominance of fragmentation injuries and the combined effects of blast waves and secondary destruction factors. The existing system of civil protection shelters is characterized by limited capacity, uneven distribution, and insufficient accessibility for the population [1].

A key limitation of effectiveness is the time factor: even a short delay in access to shelter leads to a sharp increase in the risk of injury. As a result, a gap emerges between the formal availability of shelters and their actual effectiveness.

Purpose of the Study. The aim of this research is to substantiate the effectiveness of primary mobile shelters as an element of the civil protection system, taking into account parameters such as protective capacity, deployment time, and accessibility.

Research Results. The analysis of modern combat conditions has shown that the structure of civilian injuries is predominantly fragmentation-based: the share of fragmentation wounds exceeds 60–70% [2], which determines the priority of developing anti-fragmentation protective solutions.

The effectiveness of primary mobile shelters can be evaluated using an integral indicator:

$$E = f(P, t, D)$$

where P is the level of structural protective capacity, t is the deployment time of the shelter, and D is the average access distance for the population to the shelter.

It has been established that the influence of time and accessibility parameters is nonlinear: reducing deployment time and the distance to shelters provides a significantly greater reduction in injury risk compared to a slight increase in structural strength.

The analysis of structural solutions showed that reinforced concrete shelters provide a high level of local protection, but are characterized by significant manufacturing and installation time [1]. Metal structures allow reducing deployment time by 2–3 times, but have limited ability to absorb the energy of fragments.

The most effective solutions are combined multilayer systems that ensure gradual reduction of the energy of damaging factors:

- primary destruction or deflection of the fragment;

- dissipation of kinetic energy in the intermediate layer;
- retention of residual fragments by the inner layer.

The use of granular materials (sand, soil) ensures effective energy dissipation of fragments, while the application of fibrous materials increases the ability to retain small fragments. The use of multilayer structures increases protection efficiency by 25–40% with only a slight increase in structural weight.

Additionally, it has been established that the spatial factor is critical: reducing the distance to shelters from 150–200 m to 30–50 m reduces the probability of injury by more than two times.

Conclusions. Primary mobile shelters are an effective engineering solution for increasing civilian safety in wartime conditions. It has been proven that the maximum effect is achieved through the integrated consideration of the parameters “protection – deployment time – accessibility.”

A promising direction is the development of combined multilayer structures that provide effective anti-fragmentation protection with minimal installation time.

References

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