Improvised shelters - projecting methodology and chosen aspects of building materials

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Abstract: - This paper introduces the solution of civil protection by the concealment within territorial units of the municipality with extended jurisdiction of the city of Zlín in the Czech Republic. The methods for improvised shelters evaluation and their part in the concealment system for population are presented. One part of the paper is dedicated to the analysis and the evaluation of the documentation availability for the realization of improvised shelters' construction work and their protective properties.

Key-Words: - Security Systems, Population protection, Information systems, Risk Management, Security, Shelters.

1 Introduction

The concealment of population is the unique permanent working way of protection against the aftermath of the long-term CBRN weapons effect. After the end of the cold war, the attention to population concealment provision possibilities has dropped. This step is, in terms of service costs and building-up shelter complex savings, obvious. The question is whether it was too far-reaching with destructive influence on existing installation or not.

2 Problem Formulation

The Czech Republic is faced with the query about solutions to the civil protection against the CBRN weapons effects for the future. Nowadays, the system is still based on the utilization of permanent building structures - permanent shelters (PS). In a smaller degree, it is counted on rapid construction work of suitable premises to shelters - improvised shelters (IS). In peacetime, these premises are used for alternative purposes (garages, stocks, etc.), and their adjustment for the need of the concealment in case of enhanced risk is supposed.

An "extensive onset" of IS utilization on concealment provision may bring considerable financial savings. However, it is also linked with several hazards. The IS and PS advantages and disadvantages in peacetime and at time of the national emergency and the state of war is given for comparison.

Permanent shelters		
	Plus	***Minus***
Peacetime	Used for emergency quarters	Financial demands
	Possibility of training and staff exercises	Require maintenance
		Require revision
State of peril to the country, State of war	Quick activation	Minimal
	Guarantee parameters	
	A higher degree of protection	
	Proven functionalities	
	The arrangement of the interior	
	Number of staff	

Table 1. Comparison of permanent shelters properties.

As can be seen in Table 1 and 2, the peacetime period is more fruitful for planning with the utilization of IS. On the contrary, during the national emergency and the state of war periods the PS are uniquely preferential. The optimum civil protection system by the concealment thus appears to be the combined system consisting of utilization of IS and PS. Analogical system also works in the Czech Republic (CR), where the proportion of IS continually rises while the proportion of IP decreases.

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Improvised shelters		
	Plus	***Minus***
Peacetime	Financial modesty	
	Applications for peaceful purposes (garages, warehouses)	
	Low maintenance	
State of peril to the country, State of war	A large number of objects	The need for transport of materials and equipment
	The continuous geographic distribution	The absence of facilities (toilets, filters, etc.)
		Non proven functionalities
		Limited internal space
		Non guarantee parameters
		The need for construction works

Table 2. Comparison of improvised shelters properties.

The concealment in the CR conditions is ensured by the municipalities within their territorial scope. The whole system is covered by the General Directorate of Fire Rescue Service of CR by its executive parts (Regional Fire Rescue Services).

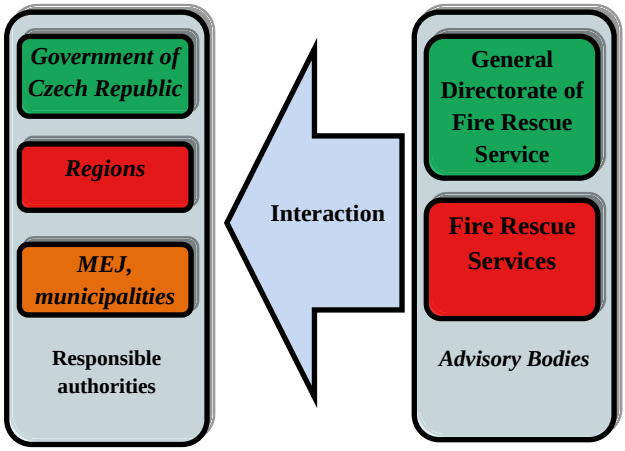

Fig.1. Population concealment system in the Czech Republic.

2.1 Problem with the concealment provision

The problem is mainly the fact that in the CR the uniform methodology for IS projecting does not exist. Express recommendations, adjustment processes and construction of IS exist, but those are rather instructions for population, and they are not widely exploitable within the municipality authorities. The fundamental document in the field of civil protection is the Government regulation No. 165/2008 - "Conception of civil protection", which unambiguously determines the responsibility for concealment provision in the territory of municipality authorities, which have to work on the adjustment of IS at the time out of the states of emergency.

The concealment is ensured by the selected staff within the frame of the municipality. However, the further coordination of the staff is problematic. Some municipalities solve this dilemma quite well by executed concealment plans, including IS projects. Some municipalities, though, solve the concealment only technically, and the real state is unsatisfying.

2.1.1 Possible development

The creation of the population concealment system in the territory of the municipality with extended jurisdiction (MEJ) may be a good solution for the provision of the system approach of the MEJ. A basic structure and parts of the system was proposed in conjunction with the Zlín municipality. The main elements of the system are especially formed by:

- **Infrastructure of the shelter**

The installation serves to the concealment of population, and the concealment support - PS, IS, material for construction work, equipment of shelters.

- **Control and planning elements**

Forces and resources for the management of preparatory, and realization concealment processes.

- **Realization elements**

Forces and resources for the provision of rapid functionality and construction work of shelters.

An important part of the system is formed by IS projecting methodology (standard), which is, due to the number of prospective IS, very important and assists in the whole standardization process. Unfortunately, similar methodology does not exist in the CR.

There are several issues to be solved in the methodology. One of them is the protective properties and availability of construction materials used for IS adjustments analysis.

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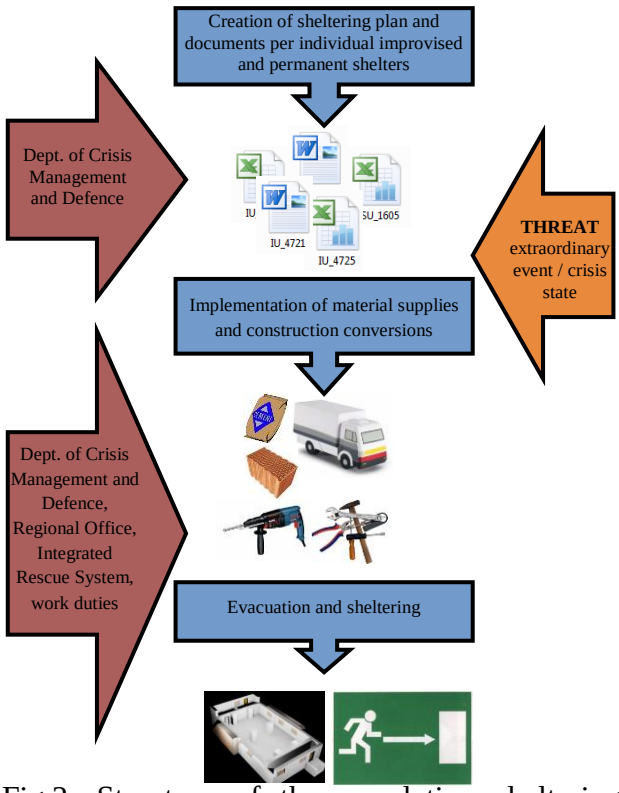

Fig.2: Structure of the population sheltering system

3 Problem Solution

The suitable support for the solution of the concealment of population is the creation of unified methodology for IS planning and projecting. This methodology allows to standardize the approach and planning of the IS, and above all to simplify the process of their projecting, accounting and construction work. Another part is formed by the suitable selection of materials used during construction work.

3.1 IS projection methodology

The basic assumption, used in the methodology proposal, is the necessity to create clear and easily understood tool.

Standard makes an essential element of the management system and planning of population protection by sheltering. It contains all the informations needed for designing constructional arrengements, calculations of needed values and shelter planning [3].

The standard consists of two parts [2]:

- Full standard – contains most of the informations. It is used for the projection of improvised shelters, required calculations and planning of protection of population by sheltering. After its filling and processing is stored in a secure place and is closed to the public.
- Reduced standard – contains informations, whose meaning is relevant for get to ready of improvised shelters - constructional arrengements, equipments ets. It is given to people that provide constructional arrengements and get to ready of shelter – document is available to public.

Full standard is processed to clarify and simple fill in of the check-list form. Its structure is composed by the following areas [2]:

a) The basic specification of the shelter processor-owner

- Address.
- Responsible persons.
- Registration (evidence) number of the shelter.
- Created by.
- Map location of the shelter.
- Use of the shelter.
- Specification of the shelter.
- Utilization.
- The type of the shelter.
- Time to get ready (time made).
- Operation time.

b) The present situation without adjustments

- TTD of shelter.
- Place proportion (size of rooms).
- Shelter plan (setup).
- Photo documentatuon.
- Building construction (type, material, value calculations of protective features).
- Potencial sources of risks in the shelter´s surrounding.
- Shelter´s equipment.

c) The suggested (proposed) adjustments

- Required (needed) material.
- A list of suggested adjustments.
- Work procedure.
- Minimal adjustments.
- Optimal adjustments.
- Installed equipment – material.
- Time schedule for performing shelter´s adjustments.

d) Situation after finishing the suggested (proposed) adjustments

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- TTD of shelter.
- Place proportion (Size of place): openings area + eventual changes of made proportions.
- Building construction (type, material, value calculations of protective features).

e) Notes, attachments, links to related documents and etc.

To facilitate the work the standard is processed in MS Word and MS Excel, which enable the effective usage in business administration (Brož 2009). It is completed by interractive plans, maps and software tools for automated calculations.

However, the creation of user-friendly tool is not enough by itself. It is mainly necessary to:
- Simplify construction work process at the most.
- Make use of widely available materials.

3.1.1 Methods (technigues) of gathering informations and procedure for filling a standard

Informations are obtained in several ways. It is mainly a study of project documenation of buildings and spaces designated for adjustment of improvised shelters. They are also used physical measurements of these spaces. In some cases, where is no possible way to find out needed data is used their estimation. Estimating datas are based on the established facts and practical experiences. At the time of filling the standard correction coefficient is being used at the estimated data to reduce possible errors caused by estimation.

3.2 Protective properties of materials used for construction work realization

The aim of IS is to lower the amount of radiation inside the shelter in comparison with the outdoor environment [1]. This property is measured by the Protective Coefficient of the Building (*Ko*), which can be calculated by the general equation No. 1:

$$(1) \quad \boxed{Ko = 0{,}65 * K_1 * K_{st} / (1 - V_2) * (K_z * K_{st} + 1) * K_m}$$

Legend:
$\mathbf{K_1}$ – coefficient of outside wall influence,
$\mathbf{K_{st}}$ – coefficient of radiation attenuation by outside wall,
$\mathbf{K_Z}$ – coefficient of radiation penetration into the room by vents,
$\mathbf{K_m}$ – coefficient of impact of adjacent buildings' effects,
$\mathbf{V_2}$ – coefficient dependent on depth of the building.

One of the basic aspects, which have the influence on protective properties of proposed shelters, is the type of materials of component units used for construction work.

Based on the analysis of the most frequent building materials for objects dedicated to the conversion to IS and evaluation of the availability of suitable materials in their neighbourhood, IS were divided into three categories, which are further divided in terms of the shipment of materials for construction work of shelters:
- IS with local availability of materials,
- IS with need for shipment of chosen materials,
- IS with need for shipment of majority of materials.

Further, the analysis shows the list of the most accessible materials scheduled in Table 3 with the information about their density, which dramatically influences their protective properties (coefficient K_{st}).

Material	Weight (kgm^{-3})	Availability
brick rubble	1200	middle, imports
crushed stone	1800	easy, imports
gravel stone	1700	easy, imports
fireclay bricks	1900	middle, imports
porous concrete blocks	800	middle, imports
paving stone	2600	easy, imports
soft wood	650	**easy, imports**
hard wood	850	**easy, imports**
steel - iron	7850	middle, imports
sand, clay	2000	**easy, local**
silt	2000	**easy, local**
masonry of solid clay bricks	1800	**easy, local**
concrete, hand stamping	2200	**easy, imports**
reinforced concrete	2400	middle, imports
lightweight concrete (pours)	300	middle, imports
cement mortar	2000	**easy, imports**
lime mortar	1700	easy, imports

Table 3: Comparison of building materials properties [3].

The availability of materials is very important and poses the primary evaluative aspect. It should be noted that the IS adjustment may be done at time of the war state, when there will be no chance for ensuring deliveries of material. The materials from

local source are, therefore, necessary to be utilized at the most.

The most suitable materials for the realization of adjustments appear to be mainly the ordinary soil and wooden materials in accordance with the results from the analysis for the district of Zlín MEJ.

4 Conclusion

Issues involved in the further research comprise especially the sphere of the filter-ventilation system and insulation properties of shelters. Our research will further verify our theories and presumptions. The cooperation with specialists in the field should have helped us to solve the issues successfully. The cooperation with specialists from the Population Protection Institute in Lázně Bohdaneč, who keep at disposal appropriate knowledge and equipment, seems to be perspective. In case of the successful solution, certification of the methodology and its employment by the municipality authorities in the CR can be expected.

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