

RESCUING FROM THE RUINS

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Received: 25th July 2023

Accepted: 12th August 2023

Review paper

Abstract: *The process of forming specialist rescue teams from ruins started in 2009 as a part of the Emergency services sector of the Ministry of Interior of the Republic of Serbia. The teams were formed with the help of the Directorate for Civil Protection of the Ministry of the Interior and Territorial Communities of the Republic of France, whose members also trained the members of the fire-rescue units and the Gendarmerie. Specialist teams are trained so that their members who work in fire-rescue units, in addition to their regular duties, provide a quick and adequate response in case of this type of emergency. This type of organization avoids the duplication of personnel, reduces expenses, rationalizes resources, and provides well-coordinated, professional teams that act quickly and efficiently. This paper deals with the systems of saving the survivors from the ruins (height and depth).*

Key words: *rescue teams, rescue systems, ruins*

1. INTRODUCTION

Rescue from the ruins requires great courage, expertise, humanity and dedication of intervention and rescue teams, as well as the introduction of new and more modern equipment. In order to improve the work of intervention-rescue teams and their safety, it is necessary to work permanently on the professional training and improvement of rescuers, define standards and rules during the intervention and rescue services. It is also important to develop a detailed protection and rescue plans. Constant cooperation with foreign teams, through the exchange of knowledge and experience in this field, as well as the organization of joint training camps, is another way to improve the response of teams in such situations.

2. ORGANIZATION OF SERVICES AND UNITS FOR RESCUE FROM THE RUINS

At the Government of the Republic of Serbia meeting on March 5, 2009, a need to establish a service for emergency situations within the Ministry of Internal Affairs arose (Sector for Emergency Situations, n.d.). A working group was formed from representatives of the Ministry of Interior, Ministry of Defense, and other ministries of the Government, with an aim of analyzing the current situation in the field of emergency situations, reviewing and proposing necessary changes to the applicable legal norms and adopting the new ones that determine the competence and actions of certain authorities in this area (Conclusion on the adoption of the action plan for the formation of a single service for emergency situations, 2009). In the session

held on June, 26th, 2009, the Government of Republic of Serbia ratified the rulebook on revisions and amendments on the internal arrangement and systematization of workplaces in the Ministry of Internal Affairs. Based on the new systematization, the Sector for Protection and Rescue has grown into the Sector for Emergency Situations. This enables the Republic of Serbia to obtain an integrated system of protection in emergencies (Sector for Emergency Situations, n.d.). The Department for Emergencies has three organizational units in its organizational structure: 1. Directorate for Preventive Protection; 2. Administration for fire-rescue units and civil protection, and 3. Risk Management Directorate (see Figure 1). In addition to the administrations, 4 Emergency Departments were formed in Belgrade, Kragujevac, Nis and Novi Sad, along with Departments for Emergencies with the headquarters of the administrative districts.

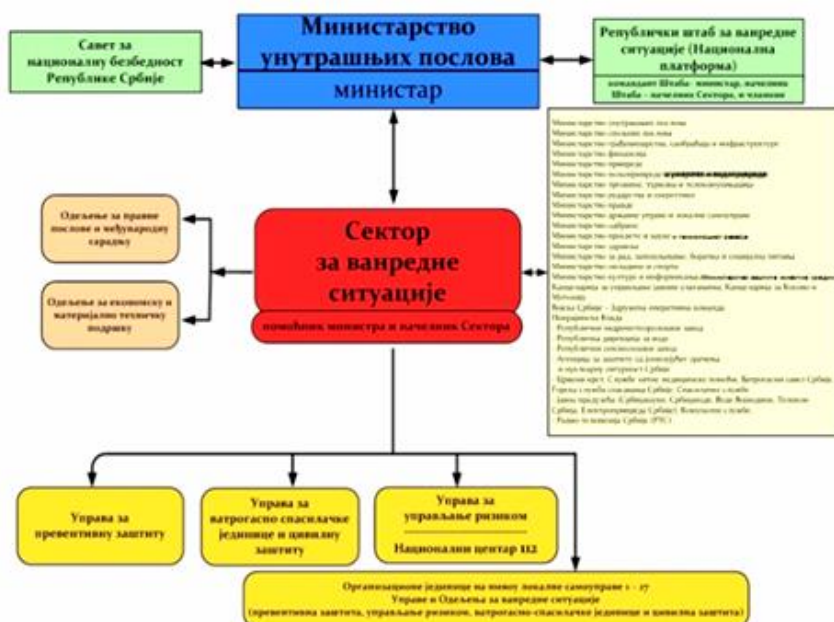


Figure 1. Organization of the emergency sector
Source: Sector for Emergency Situations, n.d.

2.1. Training of teams and formations

The training is conducted on three levels, two of which are in Republic of Serbia, and the third one is a specialist training in the centre for rescue from ruins in France. The total number of trained police officers is around 200 for levels 1, 2 and 3. The team organization was done according to INSARAG directions for USAR team forming picture 2 (Kasumacic & Salinger, 1985).

Light USAR teams (Guidelines and methodology of INSARAG, 2006) possess operational capabilities to assist with search and rescue on ground immediately after an accident, mainly coming from the affected country as well as its neighboring countries. The rescue team consists of 11 people who assigned to the Command and Group for the rescue and evacuation of the injured. The team can include canine search groups (Handbook for participants of the course for specialist teams for rescue from ruins, n.d.). In the team there can also be a medical group consisting of one doctor and one paramedic.



Figure 2. Training of members of specialist rescue teams
Source: Sector for Emergency Situations, n.d.

Medium USAR teams (Guidelines and methodology of INSARAG, 2006) possess operational capabilities for technical search and rescue operations in structural collapse incidents, capable of breaking, breaking, cutting and penetrating concrete, typically found in urban areas. International Intermediate USAR teams can travel to the affected countries and are expected to operate within 36 hours. The team consists of 46 people distributed in the following ways: the team commander and his or her deputy, the platoon command, three intervention teams, which also include pairs with canine search. The team also has a medical group composed of one doctor and one paramedic.

Heavy USAR teams (Guidelines and methodology of INSARAG, 2006) have operational capabilities for difficult and complex technical search and rescue operations at structural collapse incidents especially those involving structures reinforced with structural iron (rebar). They are intended for international assistance in the event of a sudden accident that results in the fall and collapse of multiple reinforced concrete structures, mostly located in urban areas, when the disaster response capacities of the affected country are either overburdened or the country lacks the necessary capabilities. It operates in the affected country within 48 hours. The team consists of 60 people distributed in: Command Department; Medical team; Command and Immediate Support Department; Department of Radio Communications; Media Communication Department; Technical Support Department; Logistics Department; The intervention platoon consists of three intervention departments.

Having followed the seismological map produced by the Republic Seismological Institute of Serbia, the Department for Emergency Situations formed teams according to the territorial principle (Sector for Emergency Situations, n.d.): basic teams in Belgrade, Novi Sad, Kragujevac and Nis, which are intermediate USAR teams in terms of their formation. In addition to these teams, light teams were formed in Valjevo, Bor, Uzice.

3. PERSONAL RESCUE SYSTEMS FROM THE RUINS

In cases of persons trapped on the higher floors due to the collapse of buildings and internal structures, rescue units use several techniques to access the endangered persons and safely evacuate them to the lower floors and out of the building (Handbook for participants of the course for specialist teams for rescue from ruins, n.d.) and (Kasumacic & Salinger, 1985). Rescue systems are: "HINGE", "4 POINTS"; "TYROL" (cable car); "SKATE"; "ROLLER" and "ARROW" rescue system developed by forming an arrow.

"HINGE" rescue system - the system is used for rescuing endangered persons from lower floors, and is generally limited by the length of the stretched ladders (10m) which correspond to the height of one, two and possibly 3 floors. The procedure consists of sending one group of rescuers to the floor to detect and find the victim, while the other group prepares the ladder

for descent by leaning the bottom of the ladder against the base of the wall or by tying the ladder to a fixture. After finding the victim, the first triage is performed and the victim is placed on a bed connected to the ladder, and then safely evacuated by a coordinated descent during which the group of rescuers on the ground additionally secures the bed with the help of a safety rope – figure 3.



Figure 3. Application of the "HINGE" system
Source: Sector for Emergency Situations, n.d.

The "4 POINTS" rescue system is used in evacuating lower floor victims who have to be lowered or raised in a horizontal position through an opening or hole. After completing the search of the ground and evacuating the victim to the opening where rescue is planned, one group of rescuers stays with the victim and the other goes to a higher level where they install safety ropes and connect to 4 points of the rescue trough. The technique consists in manual, uniform lifting of the vulnerable person using ropes that are tied to those 4 points of the trough. This technique is physically very demanding and depends on the physical strength of the rescuers, so it is rarely used. As this technique is mainly applied at lower levels, it is necessary to predict the leakage of explosive gases due to damage to installations during an earthquake, so it is necessary to measure the explosiveness prior rescuing and to provide rescue teams with equipment for the protection of the respiratory organs (insulation devices). Securing the terrain, searching for and setting up a place for moorings is done simultaneously with approaching the victim – picture 4.



Figure 4. "4 POINTS" rescue system
Source: Sector for Emergency Situations, n.d.

Rescue system "TIROL" (cable car) - the system is used for rescuing people from greater heights, theoretically from any floor and serves for the quick evacuation of endangered persons from high buildings. Evacuation with this technique can be carried out from the building to the ground or to the neighboring building, and even across rivers. Even though the technique allows quick evacuation, just setting up the transport system takes longer, and requires good coordination with the team on the ground – figure 5.

Rescue system "SLIDE" - the system is used to evacuate vulnerable persons from lower floors, i.e. as far as the stretcher ladder allows us (1 to 2 floors). This system is most often used because it is the simplest and fastest to set up. The injured person is placed in a rescue trough, the trough is placed on a ladder. The descent is controlled at the end of the ladder by using a safety rope on a figure "8" descender, operated by one rescuer. The injured person is placed in a bed with his or her head up, protected by a helmet and goggles – figure 6.



Figure 5. "TIROL" rescue system (cable car)

Source: Sector for Emergency Situations, n.d.



Figure 6. "SKATE" rescue system

Source: Sector for Emergency Situations, n.d.

"ROLLER" rescue system – the system is used for the evacuation of endangered persons from any floor with the help of a designed or manufactured support, i.e. anchorage ladder. The system can be hung on a ladder, a tripod, on solid pillars, on a crane, on made anchorages with the help of wooden beams, etc. This system is used when there are no other options left for pulling the victim out. It is necessary to find a solid support or place it on the spot suitable for pulling the victim out with a winch and safety ropes, at the ends of which the stretcher is fixed. This procedure allows lowering and raising – figure 7.



Figure 7. Rescue system using "ARROW" construction

Source: Sector for Emergency Situations, n.d.

"ARROW" rescue system with an improvised arrow - the construction of the arrow is done using a ladder by bringing the ladder to the place of installation. The ladder is pointed at a previously made support (anchorage). Four slings are slipped between the ladders and hooked with carabines. The so-called ropes are tied to the ends of the ropes. knot "8". We hang the ropes on all four carabines, and concurrently raise the ladder and tie the other ends of the ropes to the anchorage. When everything is secured, we climb the ladder, double check and while we are on it we can hang a roller and by using it we can pull out injured people from depths or rubbles.

4. CONCLUSION

Today, international cooperation in protection and rescue is one of the most active segments of international politics, and the exchange of experiences, experts and information is part of building a system of trust among nations and achieving stability in certain regions, and in the world as a whole. At the moment of a disaster or a major accident, a quick exchange of information about the occurrence of an accident or danger is ensured, and, if necessary, the sending of special equipment and resources or rescue teams to the affected country. The level of training of rescuers is adapted to world standards. Better equipment and constant training of members of the rescue units is a prerequisite for a safe and timely response to this type of rescue operations. Earthquakes, as one of the most severe natural disasters, puts an additional burden on rescuers in terms of a lack of operational personnel due to the fact that the team members are on a voluntary basis, without any supplements, and they are also workers of fire and rescue units, which therefore shows more formed regional teams. Until now, our country has mainly formed medium and light teams with basic sets of equipment.

All rescuers on the ground must follow the rules when acting, meaning: they have to move quietly and slowly, do not disturb the stability of the collapsed materials, always assess the durability and strength of the ground you walk on, do not move elements that support other elements (beams, furniture, etc.), do not walk near cracked walls that threaten to collapse, support such walls with some object if possible, do not use open flames or engines that can produce sparks due to possible gas leaks in the building. Personal and team protective equipment is included in the basic protection measures of the rescuer and it is used in all phases of rescuing people from the rubble. When performing a rescue operation, there are many threatening and disturbing factors, such as physical factors (noise, vibrations, poor lighting, unfavorable climatic conditions such as extreme cold and heat, high humidity, etc., biological hazards such as viruses, bacteria, fungi, parasites and the like) Additionally, constant physical effort, i.e. physical strain and non-physiological position of the body, makes it difficult for

rescuers to work. Rescuers are also exposed to very stressful situations because they are constantly under pressure and also constantly encounter severely injured people, mutilated bodies, etc., which can endanger the rescuers' mental and physical health and permanently or temporarily disable them for further work.

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