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USING THE PNEUMATIC RESCUE EQUIPMENT «LIFECUBE»

(presented DSc Sobol A.N.)

The questions of the influence of wind on the use of a life-saving cube device are considered.

Keywords: rescue, falling, pneumatic rescue device.

Problem statement. The main operational problem of DSNS Ukraine divisions at the fire extinguishing and emergency situations elimination is people rescue at threat of their life according to [1]. The people rescue problem at emergence emergency situations on objects of increased number of storeys exists. The significant amount of people perishes as a result of falling from a height. In certain situations the person jump from tower is the single opportunity to rescue itself in emergency situation. There are different circumstances which can lead to it: non-performance of norms and rules of the evacuation organization, ability loss to be guided in a dangerous situation, caused by poisoning with combustion gases, unsufficiency of rescue equipment in the emergency situation conditions, panic, and demolish building or loss wholeness structural elements of the building, the strong smoke and also action terrorists. But people rescue time has the greatest significance.

Analysis of recent researches and publications. For carrying out safe and timely evacuation of people from top floors and constructions most in rescue services of many countries fire autoladders and elbowed car lifts have been adopted widely [2]. But the fires and other emergencies of the last years in Ukraine [3] showed that their applied is not always possible following with difficult availability of access roads and time major for their using. Rescue equipment in article [4] as "the rescue kerchief" has been considered. But for its use rescuers need to reach the person, to create by means of a rope rescue system and therefore to spend particular time for rescue of the person. In articles [5-7] the possibilities of application and operational analysis of a rescue complex the ARK-2 have been considered. Shortcomings of this complex are the nonexistence maneuvering for repeated apply, complexity of an entrance to the building and the progressive deployment time.

Statement of the problem and its solution. The article purpose is the analysis of wind influence on application rescue equipment "lifecube" for rescue of people at height.

At fire extinguishing and emergency elimination the pneumatic rescue equipment – "lifecube" (fig. 1) can become an additional tool of rescue. They began to come on arms to practical DSNS Ukraine divisions [8, 9]. Advantages of this rescue equipment have been caused by the fact that reliability and rescue work autonomy group increases. This rescue equipment can be put in action quickly enough (seconds tens) by minimum number of people in operative condition unlimited number of times. At the long-term storage the rescue equipment until its use keeps the serviceability. In shelf-life does not need requirement of conducting additional checking serviceability.

Fig. 1. Pneumatic rescue equipment "lifecube"

The action principle of a device consists in the following:

• the rescue equipment volume is filled with air by means of the compressor or the smoke exhauster working for pumping;

• when falling the person there is an air-out from a device;

• as a result action of device – stop falling.

However such way of rescue can constitute danger to salvable. The man cannot get on a device or it is considerable deviate from an estimated point of falling because wind action. The sizes of such rescue equipment are 3100x3100 mm [9]. Therefore it is necessary to solve a problem of wind influence on a person point landing on a rescue equipment "lifecube".
The wind action consequences changing a line of flight of driving salvable depend on the direction of wind and design features of the building. Let's consider several reference cases of influence wind on landing point coordinates.

1. Rescued person jumps from the object level (roof, balcony, terrace, canopy, etc.) located at h height with initial velocity of V_0. In this case it is possible to estimate the variation of the falling point person, when the following data have been known: t – fall time, a – the acceleration directed horizontally owing to wind action. It has speed $V_в$ coinciding with the direction of initial velocity rescued person V_0 (the most failure case). This V_0 is independent height.

On horizontal the direction can estimate acceleration of the person so

$$a = \frac{k_0 \cdot V_в^2}{m}, \tag{1}$$

where m – person mass, kg; k_0 – the coefficient depending on the body orientation of the wind stream rescued person relatively, kg/m, to be variable from $0{,}2 \leq k_0 \leq 0{,}4$.

It's obvious that the fall time

$$t = \sqrt{\frac{2 \cdot h}{g}}. \tag{2}$$

Therefore from (1), (2) follows that displacement on an axis x

$$x = V_0 \cdot \sqrt{\frac{2 \cdot h}{g}} + \frac{k_0 \cdot V_в^2}{m \cdot g} \cdot h. \tag{3}$$

2. In a case when the direction of the wind speed vector $V_в$ perpendicular to the person jump speed vector V_0 that displacement on an axis x

$$x = V_0 \cdot \sqrt{\frac{2 \cdot h}{g}}, \tag{4}$$

but on an axis y

$$y = \frac{k_0 \cdot V_в^2}{m \cdot g} \cdot h. \tag{5}$$

The coordinate dependence of landing y at from the wind speed $V_в$ and height of finding rescued person h has been presented in fig. 2. From the schedule is visible that when the wind speed is 15 m/s and the person mass 70 kg falls from height of 15 m (the maximal height of according using rescue equipment to the tactical principal specification - 16 m [9]), then its deviation will be 1,5 meters from the falling point. It is caused by wind action. This deviation is essential and it should be considered when carrying out rescue operations.

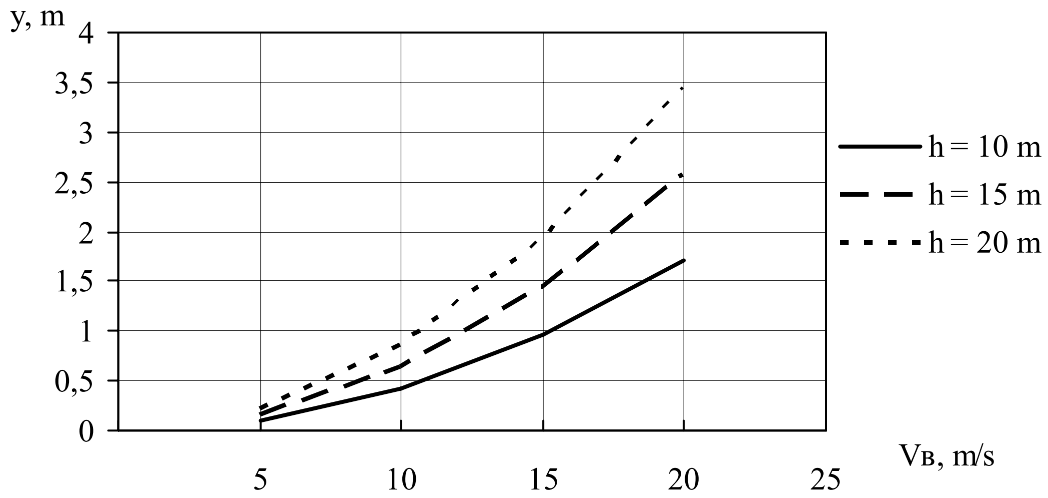

Fig. 2. Deviation coordinate dependence of the rescued person landing point y from the wind speed $V_в$ and height of finding rescued person h (k_0 = 0,3 kg/m; m = 70 kg)

Conclusions. When using a pneumatic rescue equipment "Lifecube" it has been established that it is necessary to consider wind speed. These rescue equipment at the wind speed of 15 m/s and more whenever possible not to use. Under such weather conditions to use other rescue equipment.

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Щодо використання пневматичного рятувального пристрою «куб життя»

Розглянуті питання впливу вітру на застосування рятувального пристрою «куб життя».

Ключові слова: рятування людей, падіння, пневматичний рятувальний пристрій.

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Об использовании пневматического спасательного устройства «куб жизни»

Рассмотрены вопросы влияния ветра на применение спасательного устройства «куб жизни».

Ключевые слова: спасения людей, падение, пневматическое спасательное устройство.