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Engineering

Complex Constructions for Extreme Condition

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ABSTRACT. Due to geopolitical position of Georgia mountainous relief with high snow peaks, sea-coastal areas areas including subtropics, at the same time high seismic activity, different natural risks should be taken into account such as river flows caused by heavy rains, debris flows, earthquakes. Special constructions are created, special equipment is designed to avoid unnecessary victims and to help people to survive in critical situations during natural disasters. The paper considers functional requirements and issues of new equipment such as, combined generator and rapidly erected bridges of multiple use. New solution for combining wind generator and solar concentrator is suggested. It is based on shape transformation, united structure transportable folded package, solar generator with deployed paraboloid surface and wind generator with further shape transformation. The device is used to provide electricity to the customer continuously not depending on day or night, wind or rainy weather. Two types of bridges multi-span and single-span bridges are offered. *© 2018 Bull. Georg. Natl. Acad. Sci.*

Key words: wind generator, solar concentrator, multi-span bridge, single-span bridge

Special constructions are designed to ensure functioning of building in extreme situations. On the territory of high seismic activity regardless the intensity specialists must be ready to supply protective measures for population. The main task is to build highly reinforced constructions to provide people with water, food, electricity, etc. Specific examples of equipment for extreme situations have been elaborated extreme

Solar Concentrator and Wind Generator

As it is known, solar radiation can be transformed into useful energy using active and passive solar systems. In passive solar systems, the building architectures themselves perform the role of solar radiation collector when heat collectors and heat conductors are installed in the walls, ceilings and floor elements. As for the active use of solar energy, it is mainly conducted by collectors and solar systems. Solar energy systems operated by collectors are based on the absorption of solar radiation by the collector and transformed into turbine energy, which is transferred from the tubes or directly into the air, water or oil.The direct conversion of solar energy into electricity is conducted by photoelectric

Fig. 1. The Spatial diagram of stages of wind and solar power equipment: a) the device in folded position; b) the device in the position of solar reflector; c) the device in the position of wind turbine

systems that are increasingly used in practice [1,2].

Special attention is paid to to solar thermal power plant that transforms solar energy into electricity. Solar energy accumulation of electricity is conducted in concentrators, the types of which are [3]:

1. Solar parabolic concentrators;
2. Solar parabolic reflective concentrators;
3. Solar power plants with tower-like central receiver with solar rays supplied to flat and long-faced parabolic or paraboloid reflectors.

The paper describes paraboloid reflectors of the sun predominantly used in extreme conditions and in the absence of solar radiation or night conditions. They are able to change the shape of transformation into the propeller and to convert wind energy into electricity.

In the solution of the constructive system the main principle is wind generator, which includes propeller, reducer, roller, generator, power transformer and battery [4]. The propeller rotation axis is not vertical but horizontal. Propeller blades are composed of rigid elements and are a type of sail propeller. It is also important that the propeller is multisheet. The structure of generator can be surface, coastal, shelf and sailing. Excluding the type of hover construction the proposed version is overground.

One of the major problems is to provide population and equipment with electricity in extreme situation. For this purpose, a universal device is developed by the authors that simultaneously works both on solar energy concentrations [5] and wind power generation. The Fig. 1 shows the spatial diagram of such energy equipment. The device in the folded position is shown on the first diagram (Fig. 1-a); the second diagram shows the device in the position of solar reflector (Fig. 1-b), and the third one shows the device in the position of the wind turbine (Fig.1-c).

The equipment in its composition consists of a supporting body, with a rotating platform. Drive rotating platform consists of an electric engine and a gear drive. On the brackets located on the platforms, the movable rings of four-fold mechanism are connected to the main body of the equipment and the hydrojack.

The main body of the equipment is equipped with wings sectors, hydrojack with wing locker and resolver, multiplier and generator. The main body also consists of nuthatch which together with hydrojack rell connected with a lever makes motion movement along the directing cylinder.

The device works in two contradictory modes: the first is solar energy, and the second is wind kinetic energy in turn mechanical energy. During

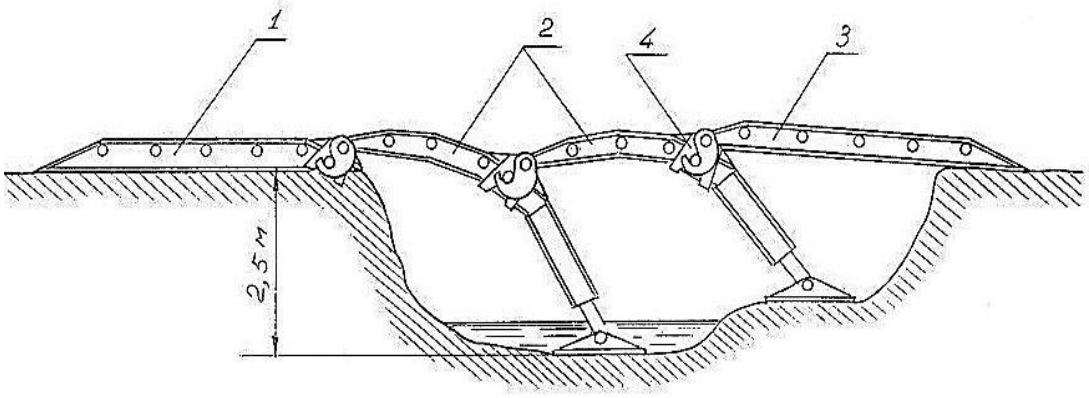

Fig. 2. Assembled-collapsible metal bridge with semilunar modul KM-01-T

the night or cloudy weather, the equipment moves in the wind regime.

Rapidly Erected Bridges of Multiple Use

The current direction of the engineering preparation of the territories is to overcome water and crossings. It is a fundamental feature of mobility demand, which is hard to achieve in the extreme circumstances, the development of modern techniques, technological processes and military art, including the development of the force of operation.

Preparing Georgian territory, infrastructures and communications for defense and military-engineering maintenance researches include the new types construction of military bridges and processing the military use of art.

The idea of creating bridges for military and civil extreme situations in the executed works is based on the creation of such types of constructions in the operations of "forcing", which is also possible to use the helicopters to build the bridge over the shortest period of time.

As for "Guide" bridges, the works cover a wide range of individual options.

In this regard, its already made and implemented two modifications of bridges – assembled-collapsible metal bridge with semilunar module KM-01-T and KM-02-T.

The scheme of the KM-01-T bridge (Fig. 2) belongs to the type of rapidly-erected bridges to pass all types of transport, including tracked modern tanks.

The constructive scheme of assembled bridge is hardly suited to any classic form, which demonstrates its uniqueness. This is a multi-span bridge with a length of span no more than 4 meters and supporting height of 2 meters. Based on this, the proposed scheme can be used for low water and low elevation passes.

The passage of the built span consists of mutual-crossing cylindrical surfaces, with the curvature along the axis of the passage. The location of the crossing line depends on the relief of the passage, but the curvature of the surface and the sizes of the built span are taken into account not to limit traffic movement.

The width of the passage provides a single flow of traffic row, but if necessary, it may reduce or increase the measures. As for the assembled-collapsible bridge with crescent modules, KM-02T, its construction is practically the modernization of the KM-01T bridge and continuation of this direction.

The design of the KM-01T model bridge and the natural measures of field examinations showed the necessity of principle and constructive changes in the assembled modules and the whole system, in a result, the unique set of the bridge KM-02T was created with its constructive scheme and operational characteristics. However, all the

positive constructive features that were reflected in the KM-01T module bridge were maintained: the geometric form of elements, the principle of self-regulation of the supports and etc., besides:

– First of all, in a result means of installation and transportation abilities, measures of the assembled module has been increased to maximum. Specifically, the width of the roadway is up to 4,2 m and the calculation length is up to 6 m.

– in this case the maximum height is not fixed and may be changed not only on account for pulling supports, but also that the part of the built module of the span is used as a support. This is achieved that the middle element of the span has the possibility of holding three project conditions in accordance with bending and the ground relief. The height of such combined support can reach 4 meters, which sharply increases the range of the use of this system to overcome the difficult relief.

– The basement of the previous module happens not with a special extra element, but by a conventional metal pipe that is a constructive part of the module and fully satisfies the functional appointment of the joint node.

As is known, the existing methods of erecting bridges, according to which interlocking slopes are going to be built between the river shores and then making a bridge over them. If the span of the bridge is bigger, then temporary interlocking slopes or ferries are made during the installation. Such methods cause the expansion of bridge construction, excess of financial and material resources.

The technical result of the invention is to increase the efficiency of the work. The result is achieved in the sections of bridges with the streched out supports placed on the slidings, which after the bridge installation is finished, it will be shifted and multi-span bridge will change to single-span one. Such procedure, in most cases, is necessary to build a multi-span bridge over the rivers, as there is ground rinse in the bottom of the supports.

Despite the fact that the inventory bridge project is created, the length of which reaches 60 meters and the installation time is from 45 minutes to 90 minutes, in extreme situations, it is actual to create rapidly-erected single-span mechanized bridge, which will be built in 2-3 minutes to overcome the obstacles.

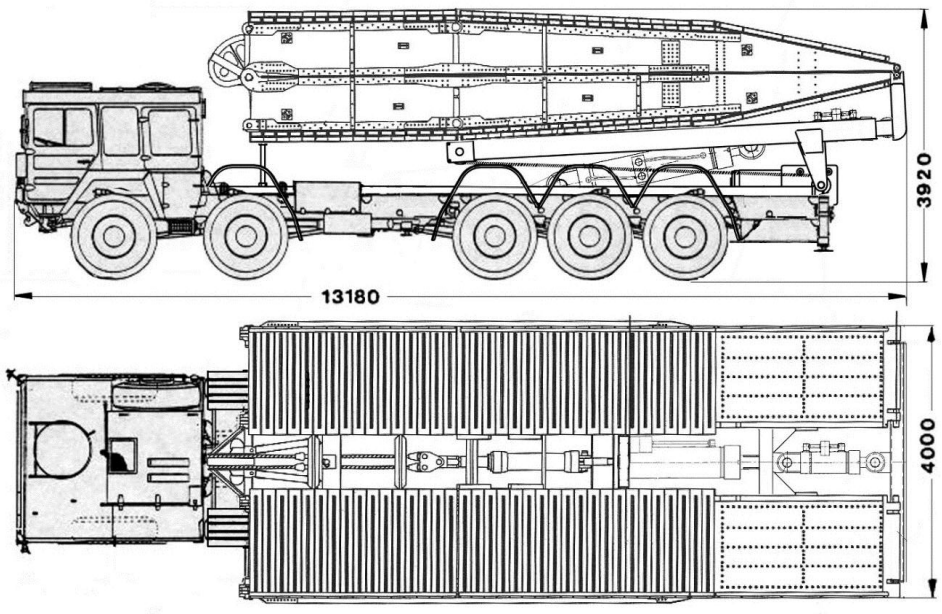

Fig. 3. Bridge-launcher vehicle on a base of MAN KAT1

Another research object belongs to single-span deployable bridges for extreme situations. Its span length is about 19.2 m. Bridge transportation and spreading and folding cross over the resistance of the Man-Firm Fourth of the Ford Vehicle KAT-1 installed on the car. Bridge and break bridges require a few minutes. The bridge can be used multiple times (Fig. 3).

The submitted version of the assembled bridge project has been developed for evacuation and road connectivity when bridges fail due to river flows and mudflows. With the help of assemble bridge, people will be able to leave places of natural disaster, and rescuers will be able to get involved in the help of injured people.

The bridge launchers are envisaged for the rapid construction of the bridge over the rivers, ravines, and various kinds of up to 18 meters wide barriers.

The bridge is provided for heavy caterpillar and wheel equipment, as well as armored one.

The development of the project was preceded by analysis and assessment of tactical-technical and operational data of the bridge-layers on the vehicle base in leading countries.

For a comprehensive study of the bridge construction and experimental studies, a full-rate, functional model of the mechanized fence complex was created at 1:10.

ინჟინერია

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§საქართველოს ტექნიკური უნივერსიტეტი, სამშენებლო ფაკულტეტი, სამოქალაქო და სამრეწველო მშენებლობის დეპარტამენტი, თბილისი, საქართველო

სტატიაში წარმოდგენილია ექსტრემალური ვითარებისათვის ნაგებობების ფუნქციური მოთხოვნებისა და კლასიფიკაციის საკითხები. კერძოდ, კონსტრუირების ახალ პრინციპებზე შექმნილი, შეთავსებული გენერატორი და სწრაფად ასაგები, მრავალჯერადი გამოყენების ხიდები. განხილულია ქარის გენერატორისა და მზის კონცენტრატორის ერთ სტრუქტურაში შეთავსების შესახებ ახალი გადაწყვეტა, მას საფუძვლად უდევს ფორმის ტრანსფორმაცია, რის შედეგადაც სხვადასხვა ეტაპზე მიიღწევა ერთიანი სტრუქტურის სატრანსპორტო დაკეცილი პაკეტი, გაშლილი პარაბოლოიდური ზედაპირის მქონე მზის გენერატორი და შემდგომი ფორმის ტრანსფორმაციით ქარის გენერატორი. ასეთი ნაგებობა უპირატესად განსაზღვრულია ექსტრემალურ პირობებში გამოყენებისათვის, რომელმაც ელექტროენერგიის მიწოდება

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