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Original article

Engineering support for the mobility of the Ground Forces of the Russian Federation

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INFORMATION

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ABSTRACT

The article addresses selected aspects of supporting the mobility of the Ground Forces in the Armed Forces of the Russian Federation. The experience of contemporary armed conflicts in which Russian forces were involved confirmed the need to maintain subunits, guaranteeing maneuver freedom in the area occupied by the enemy. The study aims to present explanations concerning: the role and tasks of the engineering troops of the Russian Federation in contemporary armed conflicts, characteristics of the currently used methods of performing mine barriers, namely mechanical, electromechanical, explosive, manual, and combined ones. Also, the essence of engineering activities according to the views adopted in the Armed Forces of the Russian Federation, the content of engineering support for mobility in tactical departments, and the interpretation of basic concepts, and the role of engineering units and subunits in the activities in question are presented. Besides, the executive potential of selected organizational and functional structures of engineering units, their purpose, and the possibility of implementing individual engineering tasks in tactical activities related to maneuvering and displacement are described. In the aspect of the issue of the impact of engineering barriers and destruction on the pace of the enemy's attack, an analysis of the execution potential and tactics of operations (doctrinal patterns of combat operations) of a potential enemy (the other party and its capability of supporting the mobility of own troops in the implementation of engineering projects related to crossings (paving) in dams, through natural obstacles and areas of destruction as well as demining terrain and objects) was performed.

KEYWORDS

Russia, engineering troops, armed conflicts, mobility support, armed forces

Introduction

The Russian Federation's modern engineering troops, which are responsible for the implementation of military engineering tasks, require the use of specialized equipment operated by qualified personnel. The engineering equipment used by the Armed Forces of the Russian Federation is mainly to improve tasks and engineering works carried out by various types of troops. Engineering troops usually use engineering equipment with an increased degree of mechanization.

The modernization program of the Armed Forces of the Russian Federation includes the ten-year State Armaments Program for 2011-2020 approved in December 2010. Its implementation is based on the purchase of new weapons and research and development work in new military technologies. The projected target of modernization is to increase modern weapons in the Russian Armed Forces from around 10 percent in 2008 to approximately 70 percent in 2020.

The modernization program is the aftermath of the broader transformation process of the Armed Forces of the Russian Federation initiated after the war with Georgia in 2008. Its goal was to move away from the Soviet Army model based on quantity in favor of quality resulting from better equipped, more mobile, and more capable Armed Forces characterized by higher combat readiness. The transformations led to a reduction in the number of military districts; the Russian Ground Forces structure and the number of the commanding staff also changed.

1. Participation of engineering forces and means in contemporary armed conflicts

The conflict in Ukraine caused Russia to lose a significant market for sourcing highly-processed components and services in the field of armaments used by its Armed Forces. At the same time, most countries of the European Union and the North Atlantic Alliance have imposed multi-faceted political, diplomatic, economic, and technological sanctions on Russia. Due to the current development of the situation and the lack of a prospect of ending the conflict, Russia will probably strive to achieve self-sufficiency in the field of military technologies, or it will expect cooperation with countries with adequate potential in this area and ready to provide such support (e.g., China, Iran).

During the conflict in Ukraine, forces and engineering resources were mainly involved in the implementation of projects related to ensuring the mobility of own troops by overcoming engineering barriers, arranging and maintaining crossings over water obstacles, preparing and maintaining roads, as well as performing tasks preventing the movement of enemy troops by building engineering dams and carrying out destruction (Fig. 1).

The conflict in Syria has become an appropriate opportunity for Russia to present new operational capabilities for many components of its Armed Forces. In the initial period of Russian troops' participation in Syria, engineering troops were mainly involved in mine clearance and cleaning up areas (or mined objects).

According to the Ministry of National Defense of the Russian Federation, in Syria, Russian sappers cleared 6.5 thousand hectares of land, 1.4 thousand km of roads, and 17 thousand different buildings and facilities (Fig. 2). One hundred five thousand explosives were neutralized (of which over 30,000 improvised ones). Military engineering specialists worked mainly in the Palmira, Deir ez-Zor, and Aleppo regions (Fig. 3); the work was completed at the end of September 2017. After the withdrawal of Russian engineering troops from Syria, demining the area and settlements has been carried out by Syrian troops since 2018[1] [See: 4].

Syria's territory was an excellent testing ground for new engineering equipment that had been produced or modernized in recent years. It provided a chance to test its performance

[1] Official data of the Ministry of National Defense of the Russian Federation.

Fig. 1. Destroyed railway viaduct on the road near Novobakhmutivka (Ukrainian: Новобахмутівка) in the Donetsk region
Source: [1].

Fig. 2. Infographic published by the Russian Ministry of Defense – the results of the actions of the Russian forces after two years of operations in Syria
Source: [2].

under real combat conditions. Engineering troops used unmanned ground wheeled or tracked platforms (*Unmanned Ground Vehicles*) to carry out engineering tasks in conditions beyond, for example, human adaptability, and minimize personnel losses while performing tasks.

n Syria, the engineering troops of the Russian Federation used the latest equipment: inductive detectors – IMP-S2[2] [5], portable cable detectors – PIPL[3] [6], portable detectors of

[2] The IMP-S2 induction detector, called NR-MD in non-military distribution (Russian: *ИМП-С2 (NR-MD)*); it is the successor of the IMP (Russian: *ИМП*) and IMP-2 (Russian: *ИМП-2*) mine detectors; it is currently used by Russian sappers, among others in the Russian operation in Syria. Its design properties make it relatively well suited for searching for ferromagnetic objects, metal detonators, mine hulls, metal projectiles, etc., which are hidden under the ground, snow, and in water.

[3] The PIPL detector (Russian: *ПИПЛ*) (on the civil market it is sold under the name NR-12C) is a detector designed to detect cables that are part of CWIED. It is a device dedicated to fast and reliable detection of thin wires (including copper wires) placed in the ground at considerable depths, designed to detect longitudinal radiation (the possibility of precise determination of the wire axis). The detector can be used to identify

Fig. 3. Russian sappers during the clearing of Aleppo
Source: [3].

non-linear junctions – NR-900EK[4] [7], sapper robots URAN-6, military robots SKARABEUSZ and SFERA inspection devices, and OWR-2-02 individual equipment sets for performing tasks in the field of land and facility demining.

2. Methods of executing mine barriers

The experience of contemporary armed conflicts in which Russian Forces were involved showed that there was a significant increase in the dynamics of operations and the insufficient effectiveness of airstrikes. Based on contemporary conflicts, the following were indicated as the priority tasks carried out during them: the destruction of communication infrastructure and crossings and transferring the effort of actions to urbanized areas. In the future armed conflict. It is the large urban agglomerations that will probably be the central area of combat operations, where mines, sabotage devices, and improvised explosives will be widely used [8, p. 7].

The conclusions of the two Chechen campaigns, the conflict in Georgia, and Russian troops' participation in combat operations in Syria confirmed the need to maintain subunits guaranteeing freedom of maneuver in the territory occupied by the enemy. Given the tactical and technical capabilities of the Armed Forces of the Russian Federation's current equipment, it can be assumed that the mechanical, electromechanical, explosive, manual, and combined methods of executing mine (classic) barriers will be used in future combat operations.

roads, terrain, and objects for the presence of electric wires that can be used to direct the detonation of mines and IED devices. The NR-12C can detect 20 m long and more electric cables, laid up to a depth of 30 cm, at the distance of 4 m from the end of the cable.

[4] Nonlinear junction detector – the NR-900EK detector (also known as Russian *ИНВУ-3М "Коршун"*) enables detection of mines and improvised explosive devices with remote control systems, electronic transmitting and receiving, electromechanical, or signaling elements. In addition, it enables the detection of magnetic, acoustic, and optoelectronic sensors as well as other ferromagnetic objects hidden under the earth's surface, on the ground (e.g., inside rooms), in snow, and in water.

The *mechanical method* of paving the passages in mine barriers is based on trawling mines by tanks (engineering vehicles) with trailer mines. Trawls mounted on tanks (KMT-7, KMT-8) and combat vehicles (KMT-10) and the IMR and BMR-3 (M) engineering vehicles can be used as the essential means of carrying out crossings in mine barriers set up by the enemy.

The *electromagnetic method* of the enemy's passage through the minefield will be to detonate mines with non-contact detonators, acting on the disturbance of the vertical component of the magnetic field intensity. The above project will be carried out through an electromagnetic device activating anti-tank mines with a magnetic detonator. The EMT electromagnetic device is designed for trawling mines with non-tactile detonators operating under the influence of magnetic field disturbances. It is an element of the KMT-7 minesweeper set and can also be mounted on tanks independently or supplemented with other types of tank-mounted trawls.

Anti-mine trawls are special and additional equipment of tanks, specialized (vehicles), and engineering machines. Trawls for pressure, trenching, pressure-trenching, and electromagnetic operation are currently used.

The tactical and technical data of selected anti-mine trawls of the Russian Federation are presented in Table 1.

In the tactics of the Grand Forces of the Russian Federation, similarly to other armed forces worldwide, the *manual method* consists in searching for mines by a sapper or infantry team using mine detectors and sapper masks. Its advantages include, among others, a significant width of the passage being made, a relatively high certainty of detecting and removing all mines from the passage, and the capability of making secret passages from time to time. On the other hand, the main disadvantages of this method concern a long time to complete

Table 1. Tactical and technical data of selected anti-mine trawls in the Armed Forces of the Russian Federation

Name of the trawl	**Way of the trawl operating**	**Carrier**	**Mass of the set [kg]**	**Trawling speed [km/h]**	**Parameters of the trawl section**	
					width [cm]	**distance between trawl sections [cm]**
KMT-7	pressure-trenching	T-72, T-80, T-90, BMR-3M	7500	6-12	80-87	162
KMT-8	trenching	T-72, T-80, T-90, IMR-3M	1000	6-14	60	216
KMT-10	trenching	BWP-1, BWP-2	450	6-15	30	240
EMT (*Электро-магнитная приставка*)	electromagnetic device activating anti-tank mines with a magnetic fuse	element of the KMT-7 trawl set, on the hooks of the front-lower fuselage plate T-72, T-80, T-90	approx. 250	12-15	400-600	(–)

Source: [8, p. 187].

the crossing (2-3 hours), a high commitment of forces, and high risk for soldiers making the crossing, especially when the dams are protected by fire. Thus, this method will be used only in exceptional cases, when the execution of the transitions by other means (explosive or mechanical) proves impossible.

The *combined method* consists in merging the mechanical and explosive or manual and explosive methods. Its main advantage is high reliability and a considerable width (8-10 m) of the passage made, while its disadvantage is the relatively long execution time, and under enemy fire – the possibility of suffering losses in human resources and equipment. It will often be used to widen passages made by other methods in the mine barriers in front of the front edge of the defense, which is performed after the first line units cross these barriers.

3. Tactics

According to Russian views, engineering support is a type of combat support, which is a combination of forces, engineering means, and tasks aimed at creating favorable conditions for soldiers to win the fight, masking engineering projects, stealthy maneuvering and deployment, implementing efficient tactical actions, increasing the protection of the fighting forces against weapons, especially against precision and nuclear weapons, and inflicting losses on the enemy and obstructing their actions [9, p. 629].

According to the instructions [See: 10], the Russian Federation's armored and motorized subunits will essentially use anti-mine trawls while conducting the attack. The tanks will be equipped with anti-mine guns so that there will be at least one pass for each platoon of first echelon tanks.

The mine barrage passages will be performed during the Fire Preparation for Attack (OPA)[5] [See: 11, p. 79] and then in the course of the attack during the fire support of the attack (OWA)[6] [See: 11]. Their number and places of execution depend, among other things, on the nature of the enemy's defense, field conditions, and the adopted offensive group.

If the attack is by dismounted subunits, then typically one path pass will be made for each attacking platoon. The same method will also apply when the attack is conducted against the enemy's well-prepared defense. On the other hand, when the attack in front of the front line of defense is carried out in the pre-combat formation, then 2-3 passes in the mine barriers will be made for each first echelon battalion (one for the attacking first-line company).

Divisions of tanks and engineering troops will make the crossings in the classic mine barrages in the attack. On the other hand, subunits of all types of troops should be able to perform passages in scatterable mine barriers without the help of engineering subunits.

Analysis of the subject literature [See: 12, 13] indicates that the fighting troops will organize pioneering groups (GT, Russian: *Группа разминирования – ГР*) in first echelon motorized

[5] Fire Preparation for Attack (OPA) – a period of artillery and other types of troops' fire activity, which usually precedes the troops' transition to the attack. The aim of fire operations in this period is, first of all, to effectively incapacitate the enemy's defense in the direction of offensive action, incapacitate (destroy) firearms, and gain the necessary fire advantage. The indirect goal is also to protect own troops from enemy fire when deploying to attack. The width of the enemy's overpowering area in the OPA depends on the width of the frontier of the first echelon troops entering fight.

[6] Fire support of the attack (OWA) – a period of artillery and other types of troops' fire activity. It is a direct continuation of the fire preparation for attack. The main goal of artillery fire operations in this period is to maintain the effects of the OPA by forbidding the enemy to recreate the fire system and increase the effects of fire preparation for the attack, and thus enable the attacking troops to achieve a high pace and maintain the continuity of the attack with minimal own losses.

and tank subunits (units). They will be primarily tasked with overcoming the prepared and deeply advanced defense of own troops, enhanced by an extensive engineering dam system. On other directions of military operations – reconnaissance and pioneering groups (GRT, Russian: *Группа разведки и разминирования – ГРР*) in mechanized units and tanks, and on the directions – frontal and parallel troops (groups) providing security (OZR, Russian: *Отряд (группа) обеспечения движения – ООД, ГОД*) will be formed.

Besides, specific forces and means will be allocated and maintained in reserve to clear passages from general military and engineering subunits, and, if necessary, from other types of troops. They will quickly make passages in mine barrages at the frontier or support the first-line troops' efforts.

The troops securing the operation of general military units and tactical units to cross mine barriers independently will create, using their own forces and resources, reconnaissance and pioneering groups (GRT, Russian: *ГРР*) to reconnaissance and execute passages in classic and scatterable barriers. For this purpose, it will be necessary to prepare troops and equip them with appropriate engineering means.

4. Executive potential

As part of the Grand Forces (WLąd), at the tactical level, engineering support tasks are carried out by sappers and engineering and sapper subunits, including:

- in a motorized battalion – a sapper platoon (plsap),
- in formed motorized and armored divisions, in tank and motorized regiments – an engineering and sapper company (kinż-sap),
- in brigades and motorized and armored divisions – an engineering and sapper battalion (binż-sap),
- within the operational units of land forces and coastal forces of individual Fleets – an engineering and sapper regiment (pinż-sap) and an maritime engineering and sapper regiment.

A platoon can deploy task groups to perform a passage in engineering dams (it can prepare extended charges (3 pcs.) in advance).

A company may deploy task groups to carry out the following engineering tasks:

- executing crossings in engineering dams (1-3 pcs.),
- paving the way through damage areas (1 road),
- maintaining 30-40 km of existing roads using the section method.

A battalion may deploy task groups or subunits to carry out the following engineering tasks:

- terrain and facility engineering reconnaissance (1 drrinż),
- maintaining 60-80 km of existing roads using the section method,
- paving roads through damage areas (2 roads),
- land demining,
- performing crossings in engineering dams (3-5 pcs.).

A regiment has the capability to perform the following engineering tasks during one day of fight:

- maintaining 80-100 km of existing roads using the section method,
- paving roads through damage areas (3 roads),

– land demining,
– performing crossings in engineering dams (3-6 pcs.).

In addition, each tank battalion of the Russian Federation can be equipped with 9 KMT-6 or KMT-8 anti-mine trawlers. The equipment is transported in the engineering subunits of the units in which there are tank battalions.

5. Influence of engineering dams and destruction on the rate of enemy attack

By analyzing the executive potential and tactics of operations (doctrinal patterns of combat operations) of a potential enemy (the opposite side), in terms of its ability to support own troops' mobility, i.e., in the implementation of engineering undertakings related to the execution of crossings (paving) in dams, through natural obstacles and areas of damage, as well as diversification of terrain and objects, the following conditions should be considered as in the content below.

In the aspect of the issues mentioned earlier, it is also necessary to consider the impact of engineering dams and destruction on the enemy's attack speed. Table 2 presents the effect of saturation with engineering dams on the enemy's rate of advance and the effect of the saturation in question on the number of the enemy's losses in minefields (the effectiveness of mine dams). Then, based on the required saturation with dams, depending on the expected effects of the use of engineering dams in individual areas (belts, zones) of mining, it was assumed that the following saturation might cause a change in the nature of the area passability (reduced accessibility):

– saturation to 0.30 – terrain easily accessible (blocking force belt or front position)
– reduction of the attack speed to 3%, enemy losses up to 3%,
– saturation from 0.31 to 1.19 – terrain limiting the pace of operation (first defense position) – reduction of the attack speed from 3% to 10%; enemy losses up to 9%,
– saturation from 1.20 – terrain significantly limiting the operation pace (depth of the main defense belt (area) and on its subsequent borders) – lowering the attack speed, enemy losses over 10%[7].

The adopted conditions, considering the impact of engineering dams and destruction on the passability of the terrain and the speed of the enemy's attack[8], are reflected in the data contained in Tables 3 and 4. These tables determine the expected success and speed (rate) of the attack for the established potential relations (attacker-defender) and field and tactical conditions (terrain availability for the operation of combat vehicles and saturation of dams).

The essential factors influencing the planning of engineering dams and the execution of damage include:

– nature of the enemy's actions,
– type of defense and the way of proceeding to its conduct,

[7] It is assumed that there will be about 10-12 combat vehicles in the attacking first echelon companies, saturation above 1.20 causes over 10% of losses of enemy vehicles entering minefields, which translates into damage or destruction of at least two combat vehicles.

[8] The issue of factors influencing the attack speed is presented in more detail in the publications by W. Więcek. *Działania bojowe batalionu. Praktyka, teoria, perspektywy*. Warszawa: Wydawnictwo Akademii Obrony Narodowej; 2015, p. 186-8; T. Wójcik. *Rozważania o współczesnym natarciu*. Warszawa: Wydawnictwo Ministerstwa Obrony Narodowej; 1987, p. 67, and A. Bujak. *Praca w terenie na szczeblach taktycznych według standardów NATO*. Warszawa: Akademia Obrony Narodowej; 2002, p. 103-6. However, the conducted

Table 2. Impact of saturation with engineering dams on the enemy attack speed and the combat efficiency of mine barriers

Saturation [abstract number]	Lowering advance pace [%]	Combat efficiency of mine barriers		
		the enemy conducts one transition to the attacking platoon (m=0.12) [%]	the enemy conducts two transitions to the attacking company (m=0.3) [%]	the enemy conducts one transition to the attacking company (m=0.35) [%]
0.10	0.99	0.84	0.21	0.21
0.20	1.96	1.68	0.41	0.41
0.30	2.91	2.52	0.61	0.62
0.50	4.76	4.20	1.00	1.03
0.70	6.54	5.88	1.37	1.44
0.75	6.98	6.30	1.47	1.54
0.80	7.41	6.72	1.56	1.65
0.90	8.26	7.56	1.73	1.85
1.00	9.09	8.40	1.91	2.06
1.10	9.91	9.24	2.08	2.26
1.20	10.71	10.0	2.25	2.47
1.30	11.50	10.92	2.42	2.68
1.50	13.04	12.60	2.74	3.09
2.00	16.67	16.80	3.50	4.12
2.40	19.35	20.16	4.06	4.94

Source: Own study.

– time to organize and conduct defense,
– terrain and weather conditions (operating environment),
– manning system, equipment, and training of engineering subunits to carry out engineering tasks.

Changes in the means of combat, new organizations, and structures of the potential enemy's ground forces [See: 16-18] affect issues related to the organization and conduct of an attack and its engineering support in overcoming mine dams. The enemy may build them against the *defending, advancing, or withdrawing* forces of the opposing side. According to the above-mentioned actions of the opposing side (own forces), the enemy's assault may take the form of *breaching, an engagement meeting, or a pursuit*.

research allows the conclusion that the presented literature does not specify the influence of the required saturation with engineering dams on the ratio of forces and the degree of resistance of the defending person and the change in the characteristics of the terrain passability (accessibility).

Table 3. Attack speed [km/h] at the brigade level and lower towards the enemy's resistance (defense prepared in advance)

The ratio of forces and degree of the defender's resistance [attacking: defender]	Defense prepared in advance					
	easily accessible area [km/h]		area limiting the operation pace [km/h]		area significantly limiting the operation pace [km/h]	
	armored/ mecha-nized	infantry	armored/ mecha-nized	infantry	armored/ mecha-nized	infantry
strong resistance 1:1	0.6	0.5	0.5	0.3	0.15	0.1
very strong 2:1	0.9	0.6	0.6	0.4	0.3	0.2
strong 3:1	1.2	0.7	0.75	0.5	0.5	0.3
medium 4:1	1.4	0.8	1.0	0.6	0.5	0.5
light 5:1	1.5	0.9	1.1	0.7	0.6	0.5
irrelevant 6:1	1.7+	1.0+	1.3+	0.8+	0.6+	0.6+

Source: [14, p. 103].

A *breakthrough* occurs when it is impossible to circumvent the defensive positions of own troops. It consists in making a frontal strike aimed at breaching their grouping. To make this breach, the enemy gathers forces and resources to gain an advantage. The breaching group's strike is preceded by fire, electronic blast, and appropriate engineering support in crossing mine barriers, the effects of which are used by the attacking forces in the air-land dimension. The enemy widens the breach towards the wings and into the defense of own troops, creating conditions for a maneuver and introducing new forces [11, p. 60].

The depth and duration of the breakthrough depend on many factors. In addition to the quantitative and fire-electronic advantage, skillful use of the conditions of the created situation depends on the method of using engineering troops to identify the system of mine barriers in front of the front line and the defended position and make crossings in the recognized dams. In general, breaching the enemy's defense is completed when the main forces of the first-line units of own troops are broken, and the breach made reaches the depth of their combat group [See: 19, p. 34].

The nature of the attack by the land forces group, the situation of its implementation, and the execution of mine barriers by the enemy speaks in favor of the necessity to pay attention to the *breakthrough section* selection[9] [See: 19, p. 35]. Terrain conditions play a significant

[9] The breakthrough section allows concentrating forces and engineering resources in a specific place and time to obtain an appropriate advantage over the enemy, which creates a high probability of making the necessary number of passes in mine barriers. The section has not changed significantly since the post-war period. Currently, it is assumed that a battalion (tactical group) breaks the enemy's defense over the

Table 4. Attack speed [km/h] at the brigade and battalion levels against enemy resistance (immediate defense, delaying action)

The ratio of forces and degree of the defender's resistance	Defense prepared ad hoc					
	easily accessible area [km/h]		area limiting the operation pace [km/h]		area significantly limiting the operation pace	
	armored/ mecha-nized	infantry	armored/ mecha-nized	infantry	armored/ mechanized	infantry
strong resistance 1:1	1.0	0.8	0.8	0.5	0.4	0.2
very strong 2:1	1.5	1.0	1.0	0.7	0.6	0.3
strong 3:1	2.0	1.2	1.3	0.9	0.8	0.5
medium 4:1	2.4	1.4	1.75	1.1	0.9	0.8
light 5:1	2.6	1.6	2.0	1.2	1.0	0.9
irrelevant 6:1	3.0+	1.7+	2.3+	1.3+	1.1+	1.0+

Source: [15, p. 67].

role. As a rule, it is designated in the vital direction of the attacking troops. It should also guarantee quick execution of mine barriers and achieving the attack target with the lowest possible losses. In this case, when the first echelon units (subunits) attack in a developed combat group, to overcome enemy barriers, all or most of them can be equipped with trench mines, with the help of which tanks cross the mine barriers independently without making any changes within the group combat [See: 20, p. 19].

In the event of weak defense of own troops, the enemy will try to *defeat* it. It consists in making strikes in the designated attack lane (without marking the breakthrough section), isolating and then breaking opposing groups, going to their rear, and chasing. On the other hand, in the dynamic situations in the battlefield and with the emphasis on the air-land nature of the attack, the enemy troops can defeat the defense of own troops on a broad front in a pre-combat group. Then, the enemy will make 2-3 passes in mine barriers (one for each attacking first-line company) for each first-line battalion.

In military theorists' opinion, the breakthrough is the most unfavorable form of attack for the attacker [See: 15, p. 46; 21, p. 17]. The constant increase in the effectiveness of modern

distance of approx. 1 km. This is an indicative calculation norm when determining the number of passes to be made in minefields and the width of the breakthrough sections at higher organizational levels of land forces; it says that the number of attacking battalions in the first echelon determines the width of the breakthrough section. This width also depends on the fire capabilities of enemy targets (objects), the effects of which should ensure relatively safe operation of engineering subunits performing passages in mine barriers and smooth forward movement of the advancing troops.

defense, especially the degree of its saturation with means of destruction (including minefields), and a significant increase in the efficiency of firearms require – as indicated by a simple dependency – using such an amount of forces and resources by the enemy that would guarantee an efficient breakthrough of own troops as well as shortening the preparatory period to a minimum. On the other hand, however, the experiences from armed conflicts at the beginning of the century indicate that the strongly fortified and deeply deployed defense ceased to be an impassable barrier for the attacker[10]. A breakthrough took on the character of spatial dissection blows, combined with a simultaneous impact on selected objects of the enemy group in the defense depths. They are only organized when it is impossible to circumvent the enemy's forces due to unfavorable terrain conditions or engineering development [22, p. 9].

Another form of attack that the enemy can perform is the *engagement meeting*[11] [See: 11, p. 61]. In the engagement meeting, each side strives to make a spoiling attack, gain an advantage, impose its will, and resolve the fight by assault. It is characterized by a limited time to organize support for the advancing troops in the collision-free crossing of enemy minefields, unclear engineering situation, striving to achieve surprise, and take the initiative by opposing parties, rapid and frequent changes in the mine situation, and the existence of gaps and open wings.

As for the implementation of engineering activities, it should be perceived as supporting the air-land fight of subsequent echelons, airborne landings, separated (raid) units, and landing and assault groups. It is combined with the simultaneous combat of the reserve and the most dangerous means of destruction with the entire depth of the groupings of the fighting parties under continuous conditions of mine threat.

In this form of attack, the basis for the success of the engineering support of the enemy troops in overcoming mine barriers includes [19, p. 37] precise reconnaissance, accurate forecasting of the mine situation development and, accordingly, adopting a combat grouping of engineering troops, disorganization of the opposing side's command system, and getting ahead of it in mastering convenient territorial boundaries, wing protection with mine barriers, and covering against air mine strikes by the implementation of engineering projects to mask the troops' maneuver.

The final form of attack is the *chase*. The chase is organized in the attack success case and finding the enemy troops' attempt to exit from the fight and withdraw. It is conducted without interruption, making the most of the available engineering forces and combat means.

A characteristic feature of the chase is the development of operations in the conditions of a mine threat at a fast pace and on a wide front, with a constant tendency to go to the wings and rear to prevent the enemy from organizing the effective defense. In this form of attack, the need to support the troops' engineering mobility in the aspect of overcoming mine barriers by the enemy is particularly evident.

Another determinant influencing the planning of engineering dams and performing destructions is the way the enemy's advancing.

[10] For example, the military operation "Iraqi Freedom" conducted by the United States in Iraq in 2003, or the Georgian-Russian conflict in 2008.

[11] A characteristic feature of this form is the rapid approach of the fighting parties and the desire to anticipate the enemy in taking over and maintaining the initiative. The essence of the engagement meeting confirms the offensive and defensive nature of modern combat operations. An engagement meeting can take place during offensive, defensive, and delaying actions.

In the doctrines [23, p. 47] it is assumed that the enemy may advance in two ways: *from the march* (with or without occupying the exit area) and *from direct contact* with the other side. Regardless of the method of conducting the attack, its course can be divided into three stages: *approach and development*, *strike* (attack and breaking the defense), and the *fight in the depths of the defense* of our troops.

The enemy troops may move to the *attack from direct contact from* a defensive position or after releasing subunits in contact with the opposing side. The contact for tank subunits is approx. 1500 m, while for infantry it is approx. 400 m [See: 24, p. 151]. Before launching the attack, the enemy performs a rearrangement (usually in conditions of limited visibility, following the rules of masking), which must be completed at the latest during the fire preparation for attack. After regrouping, the first echelon units form up places with all or part of their forces, and the tanks assigned to them – the starting bases or the waiting area. The attack begins after the enemy has overpowered the front points of resistance of the troops in contact, and after the subunits have previously seized the attack lines.

During the first stage of *a march attack*, the enemy will develop from a marching group to a pre-combat group, and then a combat group. To this end, it will designate the appropriate paths and frontiers to which the subunits will enter and change the ranks of their grouping. The line of deployment into company columns will be marked out of the range of the enemy's ground anti-tank assets, approximately 4-6 km from our leading subunits, the line of deployment into platoon columns – 2-3 km from the line of attack, beyond the range of fire of our tanks and combat vehicles [Cf. 25, p. 99].

The goal of the first stage of the attack will be the smooth exit of the enemy troops to the Line of Departure (LD). Crossing it is a complicated undertaking that requires detailed calculations and close cooperation with the neighbors. The enemy will make passages in their own barriers before the attack, and in the barriers of the opposing side (at least one per platoon) during the fire preparation for attack (OPA), after the attack of its direct covering and the surveillance areas of the barriers [See: 26]. The forces and resources of troops in contact with the enemy can also be used to complete the passages. In the event of incapacitating the first line approaching subunits and the necessity to take over their tasks, the commanders of next levels will use the second echelons or reserves.

After breaking the leading points of the opposing side's resistance, the enemy will try to break through our defensive group and go to its wings and rear to make a deep break into our grouping. In the event of encountering barriers, the enemy will first bypass or cross them, or make passages using own forces and means (mainly tanks). For IFV (TO) and other combat techniques moving behind a combat group of tanks and infantry, it will be necessary to make 1-2 passes for the attacking company.

Examples of the operation patterns of the tactical unit are presented in Figures 4 and 5.

Conclusion

The modern Engineering Forces of the Russian Federation are ready to carry out tasks in the field of military engineering, which require the use of specialized equipment, armaments and qualified personnel. The tasks that have specific and priority requirements in this regard include demining land and facilities, and performing crossings in engineering dams, as discussed in the chapter.

Properly defined and created organizational and functional structures of subunits, units, and tactical units of the engineering troops of the Russian Federation, and their presence at

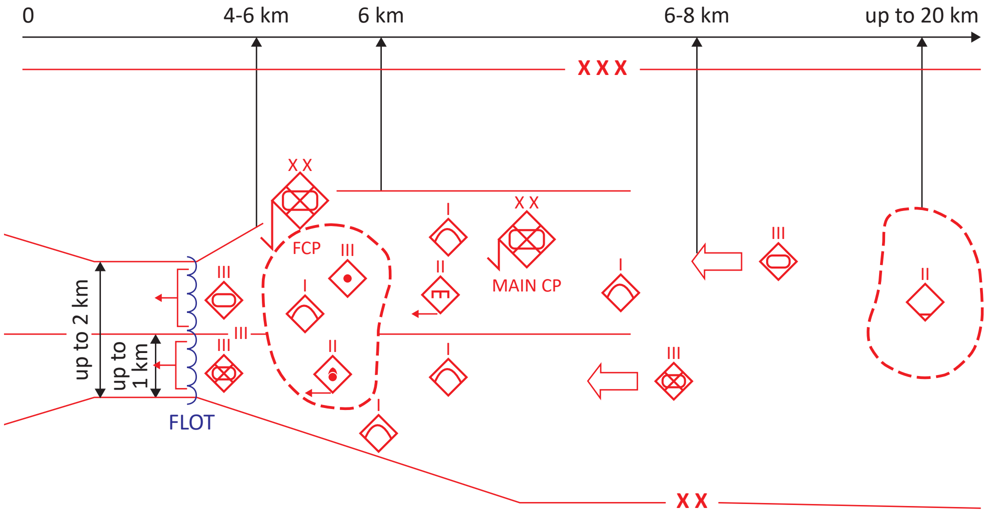

Fig. 4. The attacking division of the Armed Forces of the Russian Federation – breakthrough – variant
Source: Own study.

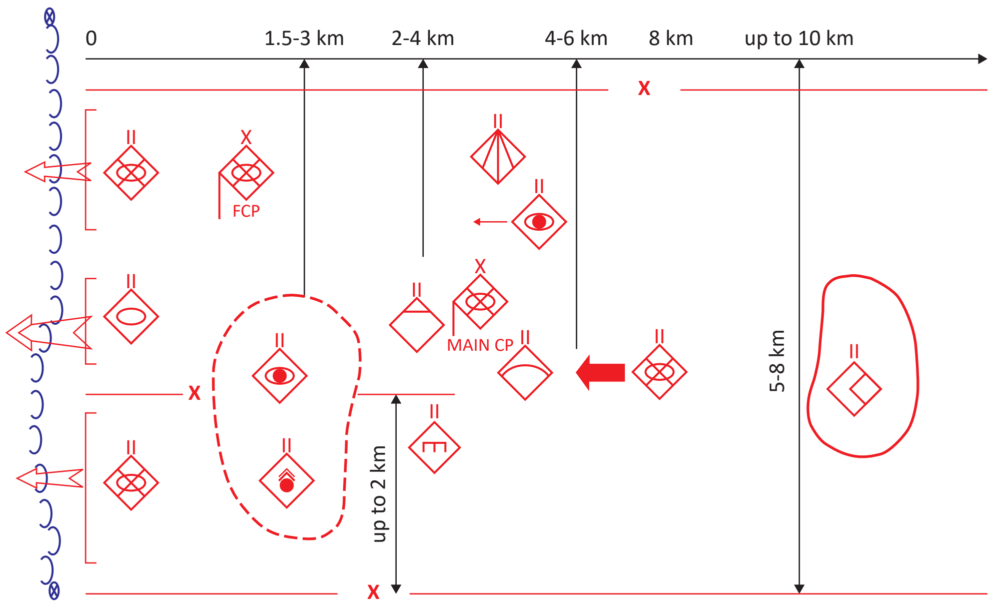

Fig. 5. The attacking brigade of the Armed Forces of the Russian Federation – grouping in one echelon with reserve – variant
Source: Own study.

almost every command level, allow the troops to be independent in the implementation of engineering projects. Thus, it provides them with the appropriate conditions for timely and their hidden deployment, development, maneuvering, and organized operation.

The considerations presented in the study boil down to the conclusion that the engineering troops' equipment is highly diversified. Its significant part was produced in the 1970s and

1980s, while the latest generation equipment, which may be comparable to the modern engineering equipment of NATO countries, is only just going to military units or is produced in single copies. The modernization of the used equipment and the new equipment successively implemented to equip subunits and units substantially contribute to increasing the level of technological advancement of the Russian Federation's engineering troops.

The Syrian campaign became a valuable testing ground also for engineering equipment produced at Russian plants after 2010. It is about specialist equipment and the individual kit of a soldier-specialist of engineering troops, means of communication, and its functioning in the framework of compatible data collection and processing systems, area monitoring with the support of unmanned air and land systems, etc. The new quality of fighting requires permanent changes in military personnel training and the adaptation of professional and specialist competencies to the challenges of the 21st-century armed conflicts.

The Russian Federation's engineering troops, participating in contemporary armed conflicts, carried out the tasks set with outstanding commitment and dedication. They gained new experience in the field of tactics of their operation and the use of new engineering equipment that has been produced or modernized in recent years. Besides, they had a chance to test their performance in real combat conditions.

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Conflict of interests

The author declared no conflict of interests.

Author contributions

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

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Biographical note

Krzysztof Wysocki – Col., Ph.D. hab. Eng., university professor at the War Studies University. The areas of the author's professional and scientific interest are mainly related to the theory and practice of military engineering, including the principles of organizing engineering activities, tactics of the engineering troops' operation, commanding units and subunits of engineering troops, and the specifics of implementing engineering tasks in various conditions environmental. The officer's interests also include the areas of operational masking and information technology, including primarily issues related to computer systems and networks. He is the author and co-author of many publications, the substantive value of which has been recognized many times, both in his home University and outside it – in military units. His scientific achievements include over 30 publications covering independent and joint studies in the field of military engineering and information technology, both in Polish and in English, e.g., K. Wysocki. *Planowanie działań inżynieryjnych z wykorzystaniem technologii informatycznych* (*Planning engineering activities with the use of information technology*). Warszawa: Akademia Sztuki Wojennej; 2019; K. Wysocki. *Inżynieryjna ocena środowiska na potrzeby kierowania działaniami inżynieryjnymi* (*Engineering assessment of the environment for the purposes of managing engineering activities*). Warszawa: Akademia Sztuki Wojennej; 2018; S. Kowalkowski, W. Kawka, K. Wysocki (eds.). *Lądowy wymiar pokonywania przeszkód wodnych przez wojska lądowe w działaniach taktycznych* (*Land dimension of overcoming water obstacles by land forces in tactical operations*). Warszawa: Akademia Sztuki Wojennej; 2018; K. Wysocki, M. Depczyński, P. Szymczak. *Współczesne wojska Inżynieryjne Federacji Rosyjskiej* (*Contemporary Engineering Army of the Russian Federation*). Warszawa: Akademia Sztuki Wojennej; 2017; K. Wysocki, W. Więcek, M. Ochalski. *Modern Approach to Tactical Activities*, Warszawa: AON; 2017; K. Wysocki, W. Więcek, M. Ochalski. *Land Forces in Contemporary Operations*. Warszawa: Akademia Obrony Narodowej; 2015; K. Wysocki. *Wybrane narzędzia informatyczne wspomagające planowanie działań inżynieryjnych* (*Selected IT tools supporting the planning of engineering activities*). Warszawa: Akademia Obrony Narodowej; 2014; W. Kawka, K. Wysocki. *Inżynieryjne dokumenty dowodzenia* (*Engineering command documents*). Warszawa: Akademia Obrony Narodowej; 2014; W. Kawka, K. Wysocki. *Ocena inżynieryjna potencjału wykonawczego Sił Zbrojnych Rzeczypospolitej Polskiej* (*Engineering assessment of the executive potential of the Polish Armed Forces*). Warszawa: Akademia Obrony Narodowej; 2011.

Wsparcie inżynieryjne mobilności wojsk lądowych w Siłach Zbrojnych Federacji Rosyjskiej

STRESZCZENIE W artykule opisano wybrane aspekty z zakresu problematyki wsparcia mobilności wojsk lądowych w Siłach Zbrojnych Federacji Rosyjskiej. Doświadczenia współczesnych konfliktów zbrojnych, w których były zaangażowane siły rosyjskie, potwierdziły konieczność utrzymywania pododdziałów gwarantujących utrzymanie swobody manewru na terenie zajmowanym przez przeciwnika. Przeznaczeniem opracowania jest przybliżenie wyjaśnień dotyczących: roli i zadań wojsk inżynieryjnych Federacji Rosyjskiej we współczesnych konfliktach zbrojnych; charakterystyki aktualnie stosowanych sposobów wykonywania przejść zaporach minowych, tj.: mechaniczny, elektromechaniczny, wybuchowy, ręczny i kombinowany. Ponadto zaprezentowano istotę działań inżynieryjnych według poglądów przyjmowanych dotychczas w Siłach Zbrojnych Federacji Rosyjskiej, treści wsparcia inżynieryjnego mobilności w działach taktycznych i interpretacji zasadniczych pojęć oraz roli oddziałów i pododdziałów inżynieryjnych w przedmiotowych działaniach. Przybliżono też m.in. potencjał wykonawczy wybranych struktur organizacyjno-funkcjonalnych jednostek inżynieryjnych, ich przeznaczenie oraz możliwości realizacji poszczególnych zadań inżynieryjnych w działaniach taktycznych związanych z manewrem i przemieszczeniem. W aspekcie problematyki wpływu zapór inżynieryjnych i niszczeń na tempo natarcia przeciwnika dokonano analizy potencjału wykonawczego oraz taktyki prowadzenia działań (wzorców doktrynalnych działań bojowych) potencjalnego przeciwnika (stronę przeciwną oraz jego możliwości wsparcia mobilności wojsk własnych w zakresie realizacji przedsięwzięć inżynieryjnych związanych z wykonywaniem przejść (torowaniem) w zaporach, przez przeszkody naturalne i rejony zniszczeń oraz rozminowaniem terenu i obiektów. Na końcu artykułu podane są najważniejsze wnioski, stanowiące uogólnienie wyników badań zawartych w poszczególnych częściach publikacji.

SŁOWA KLUCZOWE Rosja, wojska inżynieryjne, konflikty zbrojne, wsparcie mobilności, siły zbrojne

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