



Scientific and Technical Journal

## Safety & Defense 5(1) (2019) 37–45

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# Airbase as Defended Asset for Air Defense

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### Abstract

Lessons learnt during recent wars and conflicts indicate that the pivotal precondition for success is neutralization of aviation in the initial period of conflict. Eliminating aviation from combat allows us to gain advantage (superiority) in the air and provides convenient conditions for the conduct of combat activities by one's own forces. One of the ways to achieve this objective is to destroy air bases with their aircraft, security potential and infrastructure, which is necessary for their operation and proper functioning. Under these conditions, air defense of the air base becomes particularly important. The complexity of the problem stems from the increased possibility of impact from the air and the significance of the air base in aviation operations. That is why it is worth looking at the air base from the point of view of air defense.

**Keywords:** air defense, air base, air threats

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### 1. Introduction

Contemporary threats to a state require armed forces to be able to carry out a wide range of tasks. The content and scope of these tasks are usually determined by a given political and military situation. Due to airpower's attributes, equipment and combat capabilities, the Air Force is a military branch that is used chiefly to fight forces and resources of the opposing side. This is due to their high manoeuvrability, the speed of effect delivery over long distances and the very high precision of the attack resulting from the fact that they have a wide range of very modern weapons of destruction. The versatility of the Air Force makes it suitable for offensive and defensive operations.

The dynamic development of air-launched weapons observed today combined with their precision and high force of impact, causes the threat of air attacks to apply to all types of targets. This concerns not only forces engaged in direct combat, but also to those that support their operation and are located deep within the territory of a given country [1, p. 75]. Moreover, the perception of the contemporary dimension of

threats from the air is not limited to aircraft and attack helicopters. Of course, they still play a significant role in the battlefield, however, due to the development of modern technologies and their dissemination since the 1990s (in comparison to the past), their role and significance are smaller. This is essentially due to the development of new means of combat, including unmanned systems, multi-head ballistic missiles and cruise missiles [2, p. 127]. Their development is important because in the vast majority of assumptions concerning the way wars will be conducted in the future, there is a prevailing view that the classic onset of war will be the fight for dominion in the air. In this respect, it should be noted that control of the air is seen as a necessary condition for the effective use of other branches in warfare. This is basically due to the assumption that the phase of the fight for superiority in the air is of key importance, and its aim is usually to destroy military and civilian facilities which constitute the basis for the functioning of the state and its armed forces.

Among all branches of the Polish Armed Forces, the Air Force has the greatest combat capabilities to react quickly

to air threats posed to our country during times of peace, crisis and war [3, p. 75]. These combat capabilities have increased thanks to the purchase of 48 modern F-16 multirole aircraft. Under these conditions, it seems highly probable that the elimination of F-16 aircraft from combat first, followed by dealing away with the remaining tactical aircraft, may be a one of priority objectives of a potential opponent. Such an adversary is likely to seek to eliminate the full potential of combat aviation already in the first phase of the conflict, which may be decisive for the outcome of war. To a large extent, these assumptions also confirm the conclusions of the course of armed conflicts (local wars) in the 20th and 21st century. In the case of the majority of armed conflicts, when analysing their course, one may notice that the basic condition for success in warfare (operations) was the destruction of an opponent's Air Force already in the initial period of war (conflict) [4, p. 33]. The elimination of aviation from the fight made it possible for the whole armed forces to carry out offensive operations [5, p. 202].

In this situation, it should be expected that one of the most important targets that will be attacked first by the enemy's Air Force will be air bases. Therefore, maintaining them operational is necessary for the proper preparation of aircraft to carry out combat tasks within the framework of national air defense [6, p. 85, 7 p. 81]. The importance of maintaining the viability of air bases stems from the fact that military aircraft require an adequate airfield and navigation infrastructure to allow safe take-offs and landings and to provide them with adequate maintenance. Such requirements imply the need to prepare and maintain airfields operational at all times [8, p. 8]. It can therefore be assumed that air bases are one of the most important military targets [9, p. 111] in the defense infrastructure of a state due to the function of ensuring that the combat capability of aircraft is maintained in appropriate flight readiness and that they are maintained in high level of combat readiness.

In this case, the air defense of air bases is particularly important. It will be very difficult to effect, as air bases are subject to thorough recon before the outbreak of an armed conflict. In addition, they are very characteristic targets with a large area and have a stationary character. The complexity of air base air defense also results from the great potential of modern air weapons and the vast freedom of their use. Therefore, when assessing the threat to air bases, it can be concluded that an attack from the air may in fact take place from a long distance (beyond the range of one's own aircraft and anti-aircraft defense systems) [10, p. 45]. Under these conditions, air defense<sup>1</sup> of an air base with the use of aircraft and anti-aircraft defense systems seems to be a very difficult task. What is emphasised here are the current combat capabilities of anti-aircraft systems, including the lack of capability to combat ballistic missiles

<sup>1</sup> Air defense includes the implementation of passive actions (camouflage, dispersal, restoration of combat readiness, redundancy) and active actions (firing at air attack, warning about the threat of air attack). Due to the limited nature of the publication, attention has been paid only to the operation of tactical and ground aviation of Anti-aircraft Defense.

and cruise missiles<sup>2</sup>. For this reason, it is important to take action to acquire such capabilities<sup>3</sup>.

The purpose of the research was to determine what kind of asset the air base is in the context of air defense performance. The aim was gained by answering the following research questions:

What is the significance of the air base for air operations?

What kind of air threats can be deployed against air bases located in Poland?

What elements of the air base infrastructure are necessary to support the aviation operations?

During the research, theoretical methods were used, such as analysis, synthesis, comparison, inference and criticism of the literature. Among the empirical methods, the interview method with subject matter experts on air base functioning was commonly used. Interviews were conducted with the commanders of selected military units: air bases and air defense squadrons, as well as with General Staff of the Polish Armed Forces officers. Whenever the text below refers to the opinions of military experts, it follows from the interviews mentioned above.

## 2. The nature and importance of an air base for aviation combat operations

An air base is one of the most critical elements in the Air Force. Its destruction or blocking has a significant impact on the capabilities of aviation. The experience of wars and armed conflicts indicate the ever-increasing role of aviation, which, as the most manoeuvrable branch of armed forces, is able to achieve expected results in almost any conditions in the tactical, operational, and even strategic dimension. The war in the Balkans has brought the NATO Air Force new tasks [11, p. 94–95]. They are now an important factor in military deterrence and allow political-military pressure to be exerted, creating a real threat of precise and effective operation. The gradation of coercion and pressure through the threat of the use of Air Force is often the only way to enforce and maintain peace in areas of conflict nowadays. The idea of using aviation is similar in most countries. It boils down to manoeuvring operations from different airfields and at different depths of combat impact, depending on the development of the situation and the resulting operational needs.

The preparation and facilitation of aircraft operations in most countries is carried out by a specialised territorial system of the Air Force installations including, among other things, a network of air bases. According to contemporary

<sup>2</sup> The main weaponry of the Air Force Anti-aircraft Defense are the S-125 NEWA and S-200 WEGA missile systems reflecting the technical level of the 1960s and 1970s. Despite the modernisation of NEWA and WEGA systems carried out at the turn of the twentieth and twenty-first century, their combat capabilities have not changed. When analysing the potential of air defense we can have no doubt that one long-range rocket division of WEGA together with several sets of small range NEWA, (potentially supported by several subunits of Anti-Aircraft Defense Land Forces equipped with KUB and OSA systems intended primarily for anti-aircraft defense of subunits of ground forces) is not able to provide effective air defense.

<sup>3</sup> The implementation of the current WISLA and NAREW armaments programmes will result in a significant improvement of capabilities in this area.

views, the term “air base” “means (...) a large airfield (the most important element of an air base) prepared to facilitate the process of training and combat operations of an air force unit equipped with stationary equipment and means. Apart from aviation units, an air base includes anti-aircraft defense units, transport units, communications units, maintenance units, stockpiles and warehouses with material and technical means and others (...)” [12, p. 37].

The basic requirement formulated in relation to air bases is their ability to support the stationing and restoration of combat readiness of all basic types of aircraft in the Air Force. The task of air bases is to provide comprehensive logistical support of aviation operations from fixed, alternate and road runway— regardless of the type of aircraft and without the need for ground support deployment (GSD)<sup>4</sup> [12, p. 384]. The importance of an air base is closely related to the concept of using aviation in combat operations.

As stems from the research carried out, and mainly the literature analysis [13, 14, 15, 16, 17], the possibility to carry out manoeuvres is increasingly decisive for maintaining the air forces operational, and, consequently, for the effectiveness of combat operations. The need for air force manoeuvring is a result of an assessment of threats and nature of future battlefield envisaged. The current air force grouping should be regarded as the starting point for all forces to act at the beginning of an armed conflict. A manoeuvre, understood as an organised movement of subunits and air force units to new regions or new combat positions (airfields) occupies a special place in the art of air force operations, conditioning the achievement of operation objectives.

The lessons learned during wars and armed conflicts indicate that the air force, being mostly threatened by the enemy’s surprising strikes, requires special preparation for manoeuvring at the alternate airfields and road runway. One of the numerous examples is the manoeuvre in Polish aviation on the eve of the outbreak of World War II (WW II). Ground support deployments were sent to operating airfields after an alarm call-up. The aircraft changed bases on 31 August. The German side did not manage to detect changes in the dislocation so that the destruction of aircraft at airfields was avoided [18, p. 319, 19, p. 139–140]. However, the lack of such a manoeuvre caused that Soviet aviation lost about 1,200 aircraft on the first day of war on 22 June 1941, 80% of which were destroyed at airfields. The relocation manoeuvre to alternate airfields and road runway is important for maintaining combat strength. It is carried out leaving 50% of the forces at the main airfield, three formations are directed to an alternate airfield and one to the road runway [20, p. 44]. Currently, formations of aircraft to the alternate airfield based on the ground support deployment requires many organisational

and financial efforts. The manoeuvrability of the GSD will not ensure that the air force will be able to manoeuvre in a short period of time. Due to the variability and features of terrain, climate, a large number of rivers and canals, a high degree of urbanisation, the pace of the GSD march is optimally calculated at 40 km/h. The time required for the air squadron to reach combat readiness at an airfield of manoeuvre is shortened considerably in the variant of logistical support of aviation operations by the forces of an air base. It is limited to the time of take-off, flight of the prescribed route, landing and restoration of combat readiness at an airfield. The existence of a well-developed network of air bases (capable of accepting and handling all types of aircraft) allows for preparing appropriate conditions for basing and conducting combat operations by the aviation industry, while eliminating the logistical support of ground support deployments. This has a direct impact on maintaining the aviation operational through the possibility of aircraft dispersal within the passive defense of an air base.

Poland is a member of NATO and can expect on its support in the case of an armed conflict. In this context, air bases are a very important element in the area of ability to adopt such a reinforcement. The task of air bases is to logistically support the activities of the Air Force allies. “The plan for strengthening the forces of the treaty” assumes the rapid transfer of the largest possible NATO forces to various regions. This will only be possible if the countries accepting NATO forces, the so-called host nations, provide appropriate support in terms of its adoption<sup>5</sup> [21]. Due to the specificity of air force, and above all the aircraft, the HNS in the area of the Air Force may include: access to facilities, aircraft support, air traffic control, airfield infrastructure, aviation technology. In addition, it is to provide: fuel, airfield evacuation and rescue groups, current access to meteorological data and forecasts and flight plans.

In conclusion, the importance of an air base is closely linked to the development of the combat situation and aviation activities. Its importance as an air defense facility is unquestionable and insufficient air defense of an air base may have a decisive impact on aviation operations. Air bases are of great importance in the logistical support of airborne combat operations. In the initial period of combat operations in the fight for air superiority, air bases are essential for tactical aviation, which is an important part of the air defense system. Air bases also create opportunities for the dispersal (withdrawal) of aviation outside the zone of the main impact force of an opponent (assault aviation, attack helicopters, artillery) in the event of a lost fight for superiority in the air and the transition of land forces to defense operations. Air bases also provide a back-up for replenishment of losses incurred by aviation during combat operations.

<sup>4</sup> Ground Support Deployment – a separate part, usually a half, of personnel, equipment and materials from the composition of security units, serving an air force unit (subunit), capable of self-protection of combat operations and servicing an air force unit at one airfield.

<sup>5</sup> As a result of allied commitments made by Poland, seven air bases (Poznań-Krzesiny, Łask, Miroslawiec, Świdwin, Powidz, Mińsk Mazowiecki and Malbork) obtained the status of so-called Interoperable Airfields. Therefore, these are airfields to which the Aviation Support Force will be accepted in case of danger.

### 3. Identification of key elements being the target of strikes at an air base

The military airfield can be classified as one of the most important facilities of an air base, necessary to maintain the combat potential (aircraft) in appropriate efficiency and combat readiness in times of peace, crisis and war. Taking into account the importance of this facility's infrastructure for the state defense system, its elements will be the target of the destructive impact of air launched weapons of the potential opponent's armed forces. By impacting the infrastructure of an air base, such an adversary will strive to eliminate aviation from combat in order to achieve freedom of operation in the air and ensure favourable conditions for conducting combat operations by its own forces. One way of achieving this goal is to destroy airfields with their stationing aviation, security capabilities and airfield infrastructure, which is essential for their operation and proper functioning.

Therefore, the deployment of infrastructure in an air base should be considered in terms of the impact of air attacks of an opponent. Reducing the impact of air attacks in consequence contributes to maintaining the forces operational in an air base and the use of aircraft based there in accordance with the established rules. This suggests that the infrastructure should be distributed in a dispersed manner in relation to the anticipated attack with the use of the opponent's air-delivered weapons. Such facilities may include runways, airfields or individual aircraft hiding areas, weapon depots, command posts and deployment areas for specialised airborne equipment. In principle, each of these elements may be the primary target of an attack, but this will be dictated by the specific operational and tactical situation and the target of the opponent's operations.

During the WW II, taking into account the capabilities of the means of reconnaissance and destruction, it was considered that the main target of an attack in an air base would be runways. This resulted from the impossibility of masking such a characteristic facility of considerable size, but also from the assumption that if a runway was destroyed, any operation would be rendered impossible. The military conflicts after the WW II, and especially the Gulf War, have shown that runways do not always become the target of an airfield attack. Contemporary means of reconnaissance and unprecedented effectiveness of fire support measures make it possible to strike even small-scale targets from long distances and heights, with an incredible effect of destruction<sup>6</sup>.

Reducing the impact of adversary aviation can be achieved through an appropriate dispersal of infrastructure and logistics at an air base. Their excessive dispersion may cause disruptions in the performance of logistic security tasks and, consequently prolong the recovery times of aircraft, periodical maintenance and prevent rapid evacuation of aircraft in the case of an air attack. Whereas the accumulation of infrastructure and logistics in one place may result in huge losses in the case of an air attack. These factors have

<sup>6</sup> During the attacks on airfields, the main targets of the anti Iraq coalition's air strikes were the hiding places of aircraft, as well as fuel and ammunition depots. The aircraft F-111F and TORNADO were hit by bombs with a laser targeting system from a horizontal flight at an altitude of 6000-8000 m.

contributed to the development of rules for the dispersal of infrastructure and logistics at air bases.

The basic component of an air base is an airfield. Based on the provision contained in the Flight Regulations "*a military airfield is an airfield used by the Ministry of National Defense for the purposes of state defense and security, as well as a shared airfield located on the areas belonging to the State Treasury under the permanent management of organisational units subordinate to the Minister of National Defense, entered in the Register of Military Airfields and Military landing strips*" [22, p. 41].

A military airfield consists of facilities and equipment located both within and outside its territory. At the level of an airfield, elements of infrastructure serving the purpose of technical maintenance of aircraft during take-offs and landings can be distinguished. The most important elements of airfield architecture include the movement area, aircraft dispersal zones, as well as elements of the command system, air traffic control measures and flight security. An airfield could not function without elements of combat support, logistic and technical support, warehouse buildings, as well as administrative, office and barracks buildings.

**Movement area (MA)** is a part of an airfield intended for ground movement of aircraft. It covers the entire airfield surface (artificial and natural). Its basic components are: the landing area, runway, taxiways and parking spaces.

**Landing area (LA)** – it is an essential element of the movement area designed for the movement of aircraft on the ground (taxiing, take-off, landing). It consists of: the runway, taxiways and parking spaces.

**Runway (RW)** – the number of runways is determined according to operational needs, with the longest runway usually located in the main direction of take-offs and landings, called the main runway, while the remaining ones are auxiliary. A runway consists of take-off strip (TOS), shoulders and extension runways (side and front safety strips).

The glide path area is the enclosed airspace above the terrain and within the extension of a runway, in which the aircraft descends to landing or rises after take-off.

The taxiway is an important element of an airfield. The main taxiway (MTW) connecting both ends of TOS can be distinguished due to its operational use. The main part of the MTW should run parallel to TOS. In principle, the technical installation and the distance from TOS should be such that the internal edge of the MTW is at least 150 m from the edge of TOS. This road may be treated as an auxiliary (emergency) TOS and should have a straight section of the length equal to TOS, with approaches and sides free from obstacles [23, p. 16]. The MTW is made of cement concrete with a runway length and width of 12–16 m for fixed base airfields or 10 m width for alternative airfields.

The connecting taxiways (CTW) joining MTW and TOS are built in the middle of TOS and at a distance of 250–300 m from its ends. The CTW offer the possibility to increase TOS capacity, save fuel and shorten taxiing time. Auxiliary taxiways connect the MTW with the aircraft parking place and the technical infrastructure of an airfield.

Aircraft parking space (aircraft stands) are specially prepared and equipped elements of MA designed for aircraft parking and maintenance at an airfield. They are divided into:

- single parking spaces for aircraft, intended for parking and maintenance of aircraft, normally arranged in simplified<sup>7</sup> or reinforced<sup>8</sup> aircraft dispersal areas (PDA);
- group parking areas for aircraft intended for short term parking and pre-start technical maintenance of aircraft. Their number and size ensure that all aircraft at an airfield can be parked. At airfields of higher classes, equipped with artificial surfaces, two group parking places are usually designed, most often located at both ends of the MTW, as air aprons (AA). Group parking places for aircraft can be organised in four variants.

**Aircraft dispersal areas** constitute a separate area of an airfield, about 3–5 km away from the centre of a runway. They are equipped with individual aircraft parking areas, shelters for flight and ground staff, shelters for storing weaponry and other necessary means for the operation of aircraft. There are two types of aircraft parking spots. These include: ramparts and shelter hangars of reinforced concrete construction. Fortified zones are located only at base airfields. The aircraft dispersal area is also an essential area for stationing the flight crew and has at least 12 aircraft parking spaces. Individual aircraft parking spaces in the dispersal areas are about 60–120 m apart, which prevents a considerable amount of aircraft from being destroyed by shrapnel bombs in the event of an air attack.

**Elements of the command system** are located in command posts and in suitably prepared areas. An air base control station is located in the area most suitable for commanding base forces at a distance of not less than 1 km from a runway, in a heavy type shelter equipped with filtering and ventilation equipment. An air base also has an auxiliary command post. The command post of an aviation unit (subunit) is located at an airfield, in the premises of an airfield tower. An airfield tower is located in a place ensuring good visibility of a runway. Its equipment with means of communication provides the commander of an aviation unit with command on the ground and in the air. The base staff is located in masonry barracks or civil housing estates about 3–6 km away from the centre of a runway.

**Elements of communication infrastructure and flight security** are located in the field while maintaining the principles of camouflage. For this purpose, radio and radio-line station masts are located at least 1.5–2 km from the communication nodes. Radiolocation landing system and lighting devices are located on both sides of a runway, and the technical equipment of these devices is located in ramparts and camouflaged. There are two main types of communication organised in an air base: wire and radio communications and

a flight security system. Wired communication is the basic type of communication operating at an airfield. Fixed base airfields have wired communication organised on the basis of a wide network of ground cables and stationary devices. This communication ensures the exchange of information between the persons performing various functions associated with individual airfield elements and with the environment.

In the field of radio communication, we can distinguish between aviation radio communication and ground radio communications and radiotelephone communication. Aviation radio communication ensures communication with aircraft crews from the moment the engine is started, through take-off and in the course of flight to landing and engine shutdown. It ensures command, including the guidance of aviation from ground-based command posts and communication between aircraft crews. Ground radio communication is intended to ensure that the commander communicates with his superiors and subordinates. It is a reserve of wired communication in case of its failure. Radiotelephone communication is designed to ensure the circulation of information for the needs of ground services and persons in charge of airfield operations. A flight security system is organised at airfields and air bases. It is used for the timely transmission on board the aircraft of information enabling the crews to navigate an aircraft and to take them to an airfield area, road runway in any weather conditions, day and night. It also provides ground-based control of the air situation in the area of flight security scheme measures.

An airfield also includes **elements of logistics**, which enable the re-establishing combat readiness and performance of combat tasks by all types of aircraft at disposal of air forces. The type of means and their resources depend on the concept of using airfields in combat operations. They allow for the restoring combat readiness and the conducting combat activities by the based aviation for a period of several days. Storage facilities for weaponry are located at a distance of not less than 5–7 km from a runway. Due to high sensitivity to enemy assaults, the requirements for the placement of munitions depots are particularly observed. The missile preparation points are located at a distance of approximately 300–500 m from the dispersal areas. Storage facilities for materials and other objects are arranged in such a way as to ensure their rational use, while observing the principles of camouflage.

Service and technical infrastructure is one of the types of infrastructure at an airfield which guarantees its proper functioning. It consists of a complex of buildings, structures and equipment, enabling take-offs and landings as well as timely supply, maintenance and repair of aircraft. The basic buildings of service and technical buildings include a terminal, hangars, airfield propellants and greases warehouses and ammunition and bomb warehouses. In this category of facilities, we can include those that have a direct impact on flight safety, i.e. buildings of a closer and further radio beacon, a radio-frequency detector and a radio-location landing system and a take-off command post.

All the equipment of the service and technical infrastructure are located, depending on the destination, in several

<sup>7</sup> Simplified aircraft dispersal area – this is a separate fragment of an airfield with equipment necessary for the operation of aircraft, with aircraft parking spots, camouflaged earth embankments.

<sup>8</sup> Strengthened aircraft dispersal area – this is a separate section of an airfield with equipment necessary for the operation of aircraft with reinforced concrete shelters covered with earth embankments

places at an airfield, with the exception of glide paths. The base airfield is supplied with electricity from at least two independent sources [24]. In addition, at each base airfield, there is an emergency power plant, which guarantees the supply of necessary energy regardless of the supply of electricity from the national power grid.

The barracks and administrative infrastructure is intended for the stationing staff, services of the aviation unit and its supporting subunits, accommodation of persons and ensures economic, living and cultural needs.

To sum up, it should be stated that an air base contains a large number of facilities that are difficult and sometimes impossible to camouflage against the opponent who has classic and precise weaponry at its disposal. A military airfield is an area of about 600–700 hectares with a circumference of 20–30 km. It is a stationary complex visibly contrasting against the background of the surroundings. It locates point and line facilities, difficult and sometimes even impossible to hide from the opponent who has various means of identification. The basic features exposing an airfield may include [25, p. 9]:

- characteristic outline and design of artificial surfaces (runway, taxiways);
- arrangement of dispersal areas with a large amount of equipment and traffic resulting from the tasks performed;
- location in the field;
- working technical devices emitting electromagnetic waves and infrared radiation;
- air traffic in the operational area of an airfield;
- acoustic effects resulting from the operation of aircraft engines, especially during take-offs and landings.

#### 4. Identification of air threats to an air base

The threat of air launched weapons and the conditions of air defense organisation are directly related to the military threat<sup>9</sup> [26, p. 89], which concerns a period of crisis and war<sup>10</sup>. Military air threats are now, and in the near future, a source of the greatest threats to an air base. Air military threats originating from the air attack of other countries (social groups) can be used both in times of crisis and in times of war.

It should be noted that in the large modern arsenal of weapons and armaments, several groups of air attack can be distinguished, namely:

- Manned Aircraft (MA), including Fixed Wing (FW) and Rotary Wing (RW) helicopters;
- Unmanned Aerial Vehicles (UAVs);
- Cruise Missiles (CMs);
- Ballistic missiles (BMs);
- Rockets, Artillery, Mortars (RAMs);

<sup>9</sup> The term military threat should be understood as such a combination of events in international relations, in which conditions to undisturbed existence and development of a state may be limited or lost, or its sovereignty and territorial integrity may be violated or lost as a result of armed (military) violence against it.

<sup>10</sup> In this paper only military threats of the period of crisis and armed conflict are considered. Due to the volume of this paper, the threats of time of peace and non-military threats, e.g. RENEGADE, have been omitted.

- Precision Guided Munitions (PGM);
- Lighter than Air Sensor Platforms (LAPs).

Nowadays, the best defined and described group of conventional air attack are manned aircraft consisting of combat aircraft and helicopters.

It seems that the primary position of threats posed by manned aircraft results mainly from the concept of the use of armed forces. Combat aircraft of the latest generation make use of highly specialised and smart weaponry, and the so-called V generation can serve as a multi-purpose fighter, vertical take-off and landing assault aircraft and aircraft carrier fighter, as well as have stealth properties. As many military experts<sup>11</sup> point out, our nearest neighbour, Russia, disposes of aircraft which are not technologically inferior to those produced by American companies with. Analysis of official data prepared by the Russian Ministry of Defense indicates that the country's Air Force currently has about 2,750 aircraft of various classes and destinations on board. Military analysts [27] indicate that many years of neglect (mainly for economic reasons), which took place in the entire armed forces of the Russian Federation, now give way to the backlog plan that includes spending about 20 trillion roubles on new aircraft, helicopters and other weapons by 2020. The renewal of investments in the Air Force has been initiated with plans to purchase, by 2015, about 200 new multi-purpose aircraft, combat helicopters, training and transport aircraft. Russia is currently making the best example of such efforts to retrofit its Air Force by purchasing 120 Su-34 assault and combat aircraft, introducing the new Mi-28N attack helicopters, Yak-130 jet trainers and Il-112 transport aircraft into military units. It is also expected that the PAK DA strategic bomber, the successor of Tu-95 MS, will be one of the latest solutions of the Russian military industry in the coming years. It is constructed using flying wing technology, armed with hypersonic self-steering missiles and is a response to the Chinese H-20 bomber and American LRS-B (Long Range Strike-Bomber). Manned aircraft will pose a major aircraft threat to air bases. They carry specialised weapons for the destruction of facilities located at an air base. What may be indicated here are the bombs and air-to-ground missiles intended for destruction of runways, fortified objects and devices emitting electromagnetic energy.

Attack helicopters are another group of air attack. Their specific qualities, such as the ability to take off and land vertically and the possibility of hovering in the air, combined with high lifting capacity and, above all, the ability to quickly move forces to places hard to reach, make this type of aircraft still a key tool for carrying out modern combat missions of the armed forces. The Russian helicopter Mi-26 (marked as Mi-26T2) is an excellent example. These latest generation helicopters can carry up to 20 tons of cargo or 90 soldiers [28]. However, helicopters are also excellent combat tools, such as the latest generation Russian helicopter Ka-52 Alligator (NATO code: Hokum-B), which is a two-seater attack helicopter, a successor to the one-seater Ka-50. The Ka-52 Alligator is equipped with the most modern Russian

<sup>11</sup> Opinions on this subject were obtained from officers during interviews in air defense squadrons and air bases.

weaponry systems of the whole range of Hokum helicopters. The basic weapon is the AT-12 Swinger anti-tank missile with the I-251W Squall guiding system. It allows to effectively track down and attack targets from a distance of 5 to 12 km, i.e. from the target area of Ka-52 (the Squall system allows to detect a tank at a distance of up to 10 km, the effective range of the Swinger missile is 12 km). The Russians assume that the Ka-52 Alligator will not operate within a radius of less than 5 km from the target, i.e. in a strong anti-aircraft defense zone. This task is to belong to the Ka-50, while the Ka-52 is to conduct reconnaissance, indicate and destroy targets from a greater distance. According to official data, the Russian Armed Forces currently have about 1,250 helicopters of different classes and purpose [29]. Helicopters will not pose as great a threat to an air base as aircraft due to their smaller range of tactical radius. However, they cannot be completely excluded, especially in the initial phase of an armed conflict.

The group of non-classical air attack includes: Unmanned Aerial Vehicles (UAVs), Ballistic Missiles (BMs), Cruise Missiles (CMs), Rockets, Artillery, Mortars (RAMs), Precision Guided Munitions (PGM), and Lighter than Air Sensor Platforms (LAPs).

Unmanned aerial vehicles are currently an important air attack group with an impact on the air safety environment. According to the generally accepted classification, unmanned aerial vehicles are divided into: combat, reconnaissance and supportive. Currently, the most important features of unmanned aerial vehicles are: difficulty in detecting them, low operating costs (compared to manned vehicles), high reliability and combat life, the ability to take off from any place and a long hovering time. Unmanned aerial vehicles are today one of the most technologically advanced weaponry a modern army and are seen as the future of air attack.

In this respect, A. Radomyski adds that today's and future development programmes of unmanned aerial vehicles will focus on:

- the development of reconnaissance and fire tasks aimed at prolonged air presence, recognition and immediate destruction of an enemy, as well as direct support of facilities in close contact with an enemy;
- ensuring that unmanned aerial vehicles detection capabilities are limited;
- the miniaturisation of combat platforms [30, p. 35].

As pointed out in article A. Gwiazda, in 2004 only 41 countries had unmanned aerial airborne vehicles of various types and purpose. However, already in 2011, the number of these countries increased to 76, and at the end of 2013, it exceeded 80. Statistics also indicate that by 2010, 90% of the world's expenditure on the production and maintenance of UAVs was spent by the USA, while in 2013, the share of this superpower had already decreased to 64%. According to media reports from our eastern neighbour, Russia is currently working intensively to achieve full readiness to use UAVs for combat purposes in fire attacks on targets by 2020[31].

The multifunctionality of unmanned aerial vehicles makes them an object of desire of many entities subject to international law, but also terrorist groups. It seems reasonable to judge

that in the near future, the development of new military technologies, combined with the needs of the modern battlefield and economic factors, is likely to influence the decision to gradually reduce the potential of manned aircraft. They will be replaced by unmanned and universal air platforms equipped with the latest generation of detection and weapons [32, p. 16]. UAVs should be taken into case in the context of threats from the air to an air base. The latest and most technically advanced UAVs are characterised by a long range and flight time<sup>12</sup> [33] that far exceeds the capabilities of most aircrafts, as well as by a significantly lower unit cost. Due to the fact a small effective reflection surface, low emission of thermal radiation and the possibility of flight at low altitudes, their detection and destruction exceed the capabilities of typical anti-aircraft missile systems used by the Polish Armed Forces. An important feature, particularly dangerous for ground air defense units (both artillery and missile) using radars for searching objects in airspace, is the ability of UAV armed with anti-radiation missiles, to keep airspace under surveillance. The detection and guiding of missiles requires the inclusion of a radars. The station becomes a target for the anti-radiations missiles at the same time.

It is a fact that in the group of unconventional air attack are ballistic missiles. Due to tactical and technical properties, have become an excellent tool of military strikes. The large range of operation, short flight time, low susceptibility (sensitivity) to detection by radiolocation means, relatively low production cost in comparison to modern bombers and ability to carry weapons of mass destruction are the characteristic features of ballistic missiles, which make them an exceptionally useful tool for exerting pressure of both military and political nature [34, p. 23]. The threats posed by ballistic missiles to an air base result from their high velocity at the last stage of flight, making them difficult to detect and destroy by air defense. Even if a missile is detected at the moment of its launch, in the case of an intercontinental missile, after determining the region at risk of missile impact, the maximum time for alerting endangered forces or targets is about 30 minutes. For tactical missiles, this time is shorter. The most exposed (especially by the media) is the air threat resulting from the possibility of using tactical ballistic missiles. Among the potential threats, the fact that short range ballistic missiles [35, p. 78] 9K720 ISKANDER have been deployed in the Kaliningrad Oblast is the one most often mentioned. The range of missiles of up to 500 km allows for striking at air bases located almost all over the territory of Poland. The time necessary for a missile to reach its maximum range is about 10 minutes [36, p. 164].

Currently, there are many state entities on the international political scene, whose aspiration is to influence the global and regional security order. There are also less prosperous countries in this group, which, using easy access to ballistic missiles, are trying to impose their point of view on the world order. Until recently, it was believed that, with the exception of the United States, the United Kingdom, France, Russia

<sup>12</sup> RQ-4 Global Hawk can stay in the air continuously for about 30 hours, covering about 20,000 km during this time, reaching a ceiling of 18 km, transmitting reconnaissance information to the ground flight control station in real time.

and China, other countries were not technologically prepared to produce ballistic missiles. However, according to military experts, the countries that have joined the group of those that have reached the technological potential to produce ballistic missiles with a significant range are: India, Pakistan, North Korea, Iran [34, p. 24–25].

Considering the territory of Poland as an object of a potential attack, a missile weapon arsenal in the possession of Russia seems to be particularly dangerous. The tactical ballistic missiles in question have a special impact on the security environment of our country. Russia has the latest generation of ballistic missiles (SS-21 Scarab and SS-26 STONE). These missiles can be used both to gain military and, perhaps most importantly, political benefits (forcing favourable decisions by intimidating the use of their potential against important economic and political targets). SS-26 STONE missiles with a range of about 380–500 km, according to the Russian military, are to be an asymmetric response to plans to deploy the Ground Based Interceptor (GBI) defense in Poland<sup>13</sup>.

Another one of our neighbours, Belarus, although not developing TBM technology, nevertheless has a significant potential (96 sets of SS-21 and 60 Scud missiles), which in unfavourable political and military conditions can also be used as an argument for intimidation [34, p. 26].

The next decade, in the opinion of many experts<sup>14</sup>, will be characterized by a dynamic development of CMs. They are characterised by high accuracy (precise range of up to 100 m), an ability to fly at small and very small heights with the use of terrain, small effective reflecting surface and a relatively large range – about 2–3 thousand km. Some countries with advanced technology introduce stealth missiles to their armament. The vast majority of this type of missiles is used to destroy surface ships, but the modern battlefield forces them to be used also to combat ground facilities such as: centres of state control and command of armed forces, important facilities of military infrastructure, and military groupings.

With regard to the threats to air bases in Poland, the greatest concern is Russia's huge interest in the development of CMs programmes. According to Russian military experts [36], Russia wants to increase the number of cruise missiles thirty times by the end of 2020. The new technological solutions are primarily intended for the Air Force, with the plan to introduce new subsonic cruise missiles AS-15 Kent (Russian name Kh-101), which are to have an official range of 10,000 km and hit a target with a conventional 400 kg combat warhead with an accuracy of 10 metres. During the flight, they are to use the Russian satellite navigation system GLONASS. Older AS-15 Kent missiles (Russian name Kh-555) have a warhead half the size and an accuracy of 25–30 m. It is also planned to introduce Kh-102 missiles with atomic warheads<sup>15</sup>.

<sup>13</sup> This concerns the construction of missile intercepting base of the U.S. missile system. The system will be located near Slupsk.

<sup>14</sup> Opinions on this subject were obtained from officers during interviews in air defense squadrons and air bases.

<sup>15</sup> Russian Defense Minister Sergei Shoigu announced these ambitious plans of Russia after the meeting of the Russian Security Council.

The technology of CMs is being gradually improved. Cruise missiles of the future are to be adapted to the digital battlefield. This will be reflected in the ability to receive information from aircraft, unmanned aircraft vehicles, satellites or ground command posts, and to constantly update data on changes in course or attack site [1, p. 147].

The last type of military threats to which reference should be made are Rockets, Artillery, Mortars (RAM). This is not a new type of threat, because of technological solutions, but because of the fact that they are classified as an air threat category [37, p. 91]. This group of threats is particularly characteristic of the current areas of military operation. RAMs are an essential source of weaponry primarily for rebel groups, which use it to carry out attacks on military facilities (bases) and stabilisation forces. An excellent example of this is laying fire on Israeli territory by the armed armies of a Palestinian state. Terrorists has launched around 12.8 thousand missiles towards Israel since 2001. The intensity of missile launches is so high that in only three days (29, 30, 31 July 2014) approximately 320 rockets were fired on Israel [38]. It is to be expected that RAMs will continue to be a serious source of airborne hazards, not least because of their easy handling of weapons. Also, despite their simplicity, RAMs will also be very difficult air targets to combat. This is mainly due to their very small effective reflection surface of the order of 100ths of a square metre and short flight time. The threat posed by the use of RAMs in the context of an air base will concern the actions of terrorist and rebel groups. Such groups may include military mortars or their equivalents manufactured in small factories or production plants. They can fire projectiles containing up to 6 kg of explosives, with a calibre of 60 to 250 mm, over a distance of 50 m to 4 km [1, p. 165].

## 5. Conclusion

The facts presented above indicate that today's world poses an urgent need to reconsider the problems related to the defense of an air base. In aviation combat operations, an air base is an essential element of aircraft logistics security. Particularly in the initial period of armed conflict in fight for air superiority, the operations of all forces and means of defense should be aimed at the performance of tasks aimed at gaining (maintaining) air superiority. One of the main tasks of the fight for air superiority should be air defense of an air base. Due to the manoeuvring nature of aviation operations, it is necessary to have a developed network of air bases in the territory of a country, perceived as a logistical support element of the operations without ground support deployments. They should be prepared to support the operation of national and allied aircraft. In the event of a threat, air bases will be the guarantor of the rapid adoption of the allies' reinforcement. As it was the case in the past, one of the elements of defending an air base today is the ability to disperse airborne forces in order to make sure the aviation stationed there remains operational. If we take into account the fact that current military airfields are well identified, it is advisable that the ground support deployment should be able to support the operation of aircraft at



an air base outside its facilities. One should bear in mind the possibility of using state civil infrastructure (road sections of airfields, civil airports) for military purposes.

Taking into account the modern air threats and the conclusions that history dictates, the greatest threat to air bases in the first phase of an armed conflict will probably be manned aircrafts, ballistic missiles and cruise missiles. In order to protect a facility against air strikes with the use of various weaponry, it is necessary to apply various means of defense, adequate to a given threat. Fire support measures must be in place to organise a multi-layered fire zone. These should include the weaponry allowing to combat all air-delivered weapons and in the case of mass strikes, to fire simultaneously at multiple targets. In addition, an air base should be prepared to minimise the effects of air strikes. The base infrastructure should be dispersed in such a way as to make it difficult for an enemy to render it inoperational (using minimal impact potential) by eliminating its most important components, but ensuring efficient and effective supply to the air forces stationed there. Elements of the base infrastructure most important for securing the maintenance of combat readiness of the stationed aviation should be particularly protected (camouflaged, duplicated, with the maintained ability to restore their combat readiness). Moreover, the infrastructure of the base (with interpretative status) should be prepared to support the full functioning of the aviation sector of the NATO alliance.

Air defense of an air base is an important element of defensive operations in ensuring the proper functioning of the Air Force in times of an armed conflict. Proper organisation and functioning ensures that aviation can restore its combat readiness and prepare for new tasks. As a result, a potential opponent wishing to achieve freedom of operation in airspace will strive to eliminate air bases (mainly tactical aviation) from operations. This thesis can be confirmed by examples of recent armed conflicts, indicating the basic condition for achieving the goal of the conflict, which is the destruction of aviation in the initial period of conflict. Eliminating aviation from combat allows for gaining advantage (superiority) in the air and provides convenient conditions for the conduct of combat activities by own forces. One of the ways of achieving this objective is to destroy airfields with aircraft as also airfield infrastructure, which is necessary for proper functioning aircraft. An air base, as a specially prepared and equipped area with buildings and equipment ensuring take-off and landing, deployment and handling of aircraft, will therefore be one of the main targets of an opponent. Thus, it is particularly important to treat an air base as a crucial air defense facility.

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