

EVOLUTION OF THE AERIAL DEFENCE OF AIR BASES. CONCEPTS AND LESSONS LEARNED

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Abstract

The lessons learned during wars and armed conflicts indicate that the main factor influencing the aerial defence of air bases were directly related to the rapid development of the combat capabilities of aerial threats. Air bases have been lucrative targets for enemy air strikes since the first documented attack by a British aircraft on a German airfield in 1914 and have remained so for contemporary military air operations. The article discusses the evolution of concepts and lessons learned in the field of aerial defence of air bases that resulted from armed conflicts and local wars. The analysis includes armed conflicts, which, according to the author, have reflected the changes in the organisation of the aerial defence of air bases, including the repulsion of air strikes against aviation on the ground. Attention was paid to the conditions related to the aerial defence of aviation on the ground during the First World War. A more thorough analysis was made of the Second World War period, focused on the Western Front and the defence of Poland. Particular attention was paid to the Battle of Britain, noting the importance of the organisation of the radar air surveillance system in the context of the effectiveness of air defence. The focus of the analysis then shifts to the aerial defence of air bases during armed conflicts after the Second World War: the Vietnam War (1965-1973), the Yom Kippur War (1973), the defence of air bases in the Yom Kippur War (1973), and NATO operations from the air against air bases during the Deny Flight / Deliberate Force (1992-1995) and Allied Force (1999) operations. The article also makes a preliminary assessment of the aerial defence of air bases during the ongoing conflict in Syria.

Key words: air defence, air superiority, military air base

Introduction

The beginning of the 20th century saw the development and combat employment of a new weapon - the aircraft. With the development of technology, combat characteristics and capabilities of military aircraft significantly improved. The air

munitions were also improved. These changes resulted in the growing importance of aircraft on the battlefield. As a result, the need was created to ensure proper maintenance and repair facilities that provide technical preparation of aircraft for combat tasks. In this way, the first air bases were created.

Lessons learned from armed conflicts clearly show that one of the main preconditions for success in military operations is gaining and maintaining air superiority. One way to achieve this goal is to conduct effective air strikes on air bases. Because of that, ground aviation facilities such as airfields and air bases had to be capable of defending themselves against threats from both the ground and the air. It should be noted that World War I gave rise to the development of the defence of air bases. Over the years, this defence has changed in parallel with the altering of combat tactics and the development of weapons.

The history of military operations in the air dimension does not pay much attention to the aerial defence of air bases, although this topic is undoubtedly important. Most of the scientific discourse concentrates on the planning and conduct of operations in the air. Although this aspect of military air operations seems to be important, it should be noted that it would not be possible to conduct operations in the air without technical support on the ground, which solely depends on the infrastructure of air bases. Keeping air bases operational meant, among other things, providing them with passive and active defence. Both types of defence were designed to reduce the destructive impact of the enemy's aerial threats and ensure the functioning of the base and the aircraft stationed on it. This justifies the need to conduct research on the implementation of the aerial defence of air bases.

In light of the conditions resulting from the problem situation explained, it was assumed that the purpose of this article would be analysis of the evolution of the concepts for the aerial defence of air bases and assessment of lessons learned in this field during the armed conflicts of the 20th and 21st centuries. Taking into account the achievement of the assumed goal, it became necessary to solve the following research problem: How have air strikes against air bases evolved and how has aerial defence developed throughout history?

The problem of the aerial defence of air bases has not been widely discussed in literature. Typically, it has constituted a brief addition to the main themes of air warfare. Polish and English-language books and articles were studied during research on the evolution of air strikes on air bases and lessons learned during armed conflicts of the 20th and 21st centuries. Based on the analysis of the content, it can be stated that information on the evolution of aerial defence of air bases was scattered in about fifty items of scientific, didactic and journalistic literature.

The most useful and important works, which helped in conducting analysis of the air strikes on air bases and their defence in various armed conflicts included monographs by Marian Kopczewski and Zbigniew Moszumański „*Polska artyleria przeciwlotnicza w wojnie obronnej 1939 roku*” and „*Polska obrona przeciwlotnicza w latach 1920-1939*”. An equally valuable reference work was the study by Stefan Czmur „*Walka o panowanie w powietrzu*”. Research on air bases in Arab-Israeli conflicts was facilitated by the monographs of Adam Radomyski „*Gorące niebo nad*

bliskim wschodem”, *Obrona powietrzna w wojnach arabsko-izraelskich 1967-1982*”, „*Obrona powietrzna we współczesnych konfliktach zbrojnych, Wietnam (1964-197)*” and „*Wietnamska tarcza przeciwlotnicza*”. Scientific works in English that helped in analysis of the concepts and conduct of air defence included the monograph by John F. Kreis „*Air Warfare and Air Base Air Defense 1914-1973*” and the study by Alan I. Vick “*Air base attacks and defensive counters. Historical lessons and future challenges*”. The monograph by R. Kohn and J. Harahan „*Air superiority in World War II and Korea*” was also of great importance for historic analysis of the aerial defence of bases during World War II and the Korean War.

Aerial defence of air bases during World Wars I and II

The need for the aerial defence of air bases in all armed conflicts was a derivative of existing air threats. During World War I, the military commanders did not consider aviation as an important combat tool. It served only for reconnaissance and observation purposes. It occasionally occurred that the air force performed air strikes. They were carried out using non-specialist weapons (grenades or gasoline containers that were thrown by the pilot or observer from the plane)¹. In the first months of the war, planes took off and landed by using a variety of “rapidly” selected areas, usually different every day. Most of the airfields from the beginning of World War I were usually flat terrain, glade, or a piece of field, i.e. flat spaces on which an aircraft could land. The change of the character of military operations from maneuvering to positional later during World War I became an impulse for the emergence of more permanent air base infrastructure. Airfields remained in the same place for longer periods, and the facilities were more durable and more reminiscent of the air base². Air bases started to be covered by anti-aircraft defence forces, which carried out this task in addition to the defence of land forces. An interesting example in this field may be the defence of the Zeppelin base. The implementation of these machines into service improved German military’s ability to conduct reconnaissance and long-range strikes. For this reason, the base became a target for allied air attacks. Ground service of the dirigible base replied with rifle fire and antiaircraft guns³. The air attack was a determinant for new thinking in the use of air force in military operations. Winston Churchill, representative of the British Admiralty, encouraged further attacks on air bases, claiming that this was the most effective way to combat enemy aviation - destroying aircraft on the ground at their home air bases⁴. Air attacks on Zeppelin bases provided

1 W. Raleigh, *War in the air*, Oxford 1922, p. 395-400.

2 M. Maurer, *The U.S. Air Service in World War I*, vol.4, Washington 1978, p. 148.

3 Avro 504 aircraft participated in the raid, each of them could take up to 80 pounds (40 kg) of bombs.

4 S. Czum, *Walka o panowanie w powietrzu*, Warszawa 1988, p. 33.

the stimulus for the emergence of a new type of aircraft, whose tasks were initially to defend the bases and later to defend the bomber aviation - fighters⁵.

It is worth mentioning the battle of Ypres, during which the Royal Flying Corps (RFC) implemented new tactics of aerial deep strikes from various levels of flight (today we could call them air interdiction). Air strikes were performed on a number of targets located in the enemy's rear, including the air bases. Bomber aircraft were assigned to carry out strikes from high altitudes. The bomber aircraft were escorted by fighter aviation, which carried out the attacks against facilities of air bases from lower altitudes. Simultaneous air attacks from various altitudes caused great difficulties for aerial defence of air bases which had to divide their attention into two separate areas of airspace⁶. More frequent air strikes on air bases forced both sides of the conflict to undertake actions aimed at minimising the effects of their actions. Means and measures appeared that were dedicated to the active anti-aircraft defence of air base facilities. For this purpose, three-inch (76.2 mm) anti-aircraft guns were used, supported by general purpose guns (machine guns) and anti-aircraft lights. There were also Lewis twin machine gun formations (12 weapons each, assigned to each air base)⁷.

Passive air defence began to be implemented at air bases during World War I. For this purpose, additional airfields with hangars and technical buildings were built⁸. Camouflage and deception against the enemy air reconnaissance were used in order to protect its own aircraft at the air bases. The upper surfaces of planes were painted with a pentagon pattern of bronze, black, purple and green. The color scheme caused the planes to merge with the ground and it was more difficult to locate them from the air. The decoy air bases were built near the main operational airfields⁹. All sides used anti-aircraft artillery for area defence rather than for point defence at that time. The area of operation of land forces was defended, a point defence was used to a small extent, and typically for such as assets as communication centres and air bases. The main reason for employment of anti-aircraft guns for area defence was the limited amount of anti-aircraft weapons and their imperfect ballistics and accuracy. As a result, the aerial defence of air bases in World War I employed non-specialist, general purpose weapons, camouflage, deception, and dispersal of aircraft.

The situation related to the aerial defence of air bases changed dramatically when World War II started. The scope and intensity of air operations conducted during World War II exceeded the expectations of the most experienced air force officers. In the initial period of the war, German attacks on the enemy's airfields were an integral part of the blitzkrieg activities. The German Air Force sought to destroy

⁵ W. Raleigh, *War in the air...*, op. cit., p. 281-297, p. 324-326, p. 442-445.

⁶ J.F. Kries, *Air warfare and...*, op. cit., p. 12.

⁷ *Ibidem*, p. 14.

⁸ R.H. Fredette, *Sky on fire. The first battle of Britain 1917-1918 and the birth of the Royal Air Force*, New York 1966, p. 102.

⁹ *Ibidem*, p. 102.

enemy air power on the ground by massive surprise attacks. It was a way to gain air superiority, and it worked until the critical moment of the war - the Battle of Britain. The German invasion of Poland of September 1939 was rather an exception to further Luftwaffe successes in attacks on air bases. Polish aviation was not caught by surprise on the ground at its air bases. Passive air defence focused on dispersal of the aviation assets¹⁰. Before the German attack, on August 30, all aircraft were dispersed to temporary airfields from their major peacetime air bases. Air bases were left with a limited number of non-operational aircraft used as decoys. Dispersal protected Polish aircraft from immediate destruction on the ground¹¹. On the other hand, one must note that active air defence of Polish air bases was not effective during the September 1939 campaign. An inefficient communication system resulted in the lack of warning about the approaching air threat. The situation improved with the use of reconnaissance aircraft, which transmitted information about the direction from which the enemy aircraft would arrive via radio. This information was useful especially for fighter aircraft, which used the advantage of maneuverability and were able to intercept German bombers. The ground air defence announced its presence during the defence of three air bases located near Dęblin. German aircraft, under fire from Polish anti-aircraft artillery, were forced to increase flight altitude to stay beyond the range of artillery fire, which reduced the accuracy of bombing¹².

The Allied operation to defend Western Europe and the air bases there ended in a fiasco similar to the defensive campaign of Poland in September 1939. The modern German air force had not only better aircraft, but also provided air defence for its own air bases in the event of retaliatory strikes by the Allies¹³. During strikes on the airfields, the Luftwaffe divided aircraft into specialist tactical strike groups. While the anti-aircraft defence was occupied by the first strike group (which may be compared to contemporary SEAD), the second group arrived at a low altitude carrying out a bomb attack on the air base infrastructure, mainly hangars with personnel. One of the disadvantages of the aerial defence of air bases at the beginning of WW II was the lack of a warning system. Detection of the enemy's aircraft was carried out on the basis of imperfect sound sensors supplemented by visual observation. There was also no electronic notification network, so information from the radar posts was sent to air defence units with extremely long delays¹⁴. It is worth noting, however, that these aerial defence problems were noticed. In January 1940, General Joseph Doumenc was entrusted with the mission to improve the situation in the area of French air defence. Doumenc proposed reinforcing the defence of French air bases with a total

10 J.F. Kries, *Air warfare and air base air defense*, Office of Air Force History United States Air Force, Washington 1988, p. 56.

11 M. Kopczeński, Z. Moszumański, *Polska obrona przeciwlotnicza...*, op. cit., p. 139-140.

12 *Ibidem*, p. 115.

13 J.F. Kries, *Air warfare and...*, op. cit., p. 62.

14 W. Murray, *The Luftwaffe against Poland and West*, Washington, DC: U.S. Government Printing Office, 1994, p. 45.

number of 2100 medium and short range anti-aircraft guns. Already at that time, attention was drawn to the use of weapons with various capabilities in this field. German air attacks were carried out throughout the entire campaign in accordance with the original Luftwaffe plan, aimed at gaining air superiority. The actions of the German air force focused on French and British air bases located in France. Literature records that about 75 airports were successfully attacked by the Luftwaffe. By May 12, the initial Advanced Air Striking Force (AASF)¹⁵ of 135 bombers had fallen to 72. Most of the AASF aircraft were destroyed on the ground. The RAF had too few fighter planes and insufficient anti-aircraft defence. The biggest shortcoming was the lack of a warning system¹⁶.

The Battle of Britain was another telling example of the importance of fighting for air superiority and stakes related to the aerial defence of air bases. The Luftwaffe's successes on the continent did not translate into action against air bases located in Great Britain. The Royal Air Force's advantage was the radiolocation, thanks to which the RAF command centres could determine the enemy's flight patterns well in advance, which ensured optimal use of fighter aviation¹⁷. One of the most important elements that contributed to the victory of the British military was the well-organised aerial defence of air bases supported by the system of warning and guiding aircraft¹⁸. The next advantage during defensive operations was the use of the IFF aircraft identification device. Although it did not always work properly, in most cases it allowed air traffic controllers to distinguish which aircraft belonged to the RAF on the screen radar. Because of this, controllers were able to direct the fighter aircraft against hostile aviation formations and, on the other hand, direct their own fighters to the nearest air bases and ensure their safe admission to the airfields¹⁹. Active and passive air defence measures were used at RAF bases. The main weapons were anti-aircraft 40 mm cannons used at air bases against dive bombers and aircraft attacking at low altitudes. Passive air defence measures were also used widely. The aircraft camouflage in the RAF was established and a pattern of painting aircraft was used to reduce their visibility from the air. The upper surfaces were painted in a combination of dark green and dark soil. This reduced the possibility of detecting an airplane on the ground and in the air²⁰. The infrastructure of the air bases was also hidden from aerial reconnaissance. Most of the technical buildings of the RAF air bases had a masonry structure placed on grassy ground, which had a high contrast and was

15 The British Air Forces in France, had two main parts. The tactical arm was the BEF's Air Component while the bombers made up the AASF, a bombardment organisation independent of the ground force and operationally controlled by Bomber Command in the United Kingdom. The AASF included two battle squadrons, eight squadrons of Blenheim bombers and two squadrons of Hurricanes to protect airfields.

16 R. Jackson, *Air war over France*, Littlehampton Book Services Ltd 1975, p. 135.

17 R. Colier, *Eagle day*, New York 1966, s. 269.

18 *Ibidem*, p. 269.

19 J.F. Kries, *Air warfare and...*, op. cit., p. 81.

20 G. Hartcup, *Camouflage, a history of concealment and deception in war*, New York 1980, p. 133.

perfectly visible from the air. An example of well-organised air defence may be the Biggin Hill air base, which at the same time was the control and reporting centre for fighter planes²¹ and was the most important asset for the RAF Fighter Command. During the massive Luftwaffe air raids on Biggin Hill, anti-aircraft artillery played a significant role, despite the fact that it did not have spectacular successes. Its role was mainly to create a threat for enemy pilots. Bofors anti-aircraft guns and machine guns forced German pilots to fly at higher altitudes, making the bombing less efficient and enemy planes easier to intercept by the RAF fighters. For this reason, the anti-aircraft artillery was not a direct source of Luftwaffe losses, but was a strong link in the defence of the air base, creating favourable conditions for fighter aviation²².

The Biggin Hill air base was an example of a military facility prepared according to the accepted rules of camouflage. In order to blend with the surrounding area, artificial plantings of forests and hedges were made. The bright colours of the aircraft stood for airplanes and the foreground of the hangars were toned down with asphalt. Technical service hangars and aircraft were painted orange, not to hide them, but to distort their silhouettes to deceive the enemy. Runways were painted in a dark colour that merged with the surroundings, while the buildings remained visible from the air, but they were painted in patterns that masked their real appearance. To deceive the enemy, the RAF constructed decoy airfields with imitated infrastructure. German bombers repeatedly attacked decoy air bases²³. Aviation dispersal was also applied. Entire squadrons were moved to smaller satellite airfields in order to bring the enemy problems related to targeting²⁴.

Aerial defence of air bases during the conflicts of the Cold War period

Lessons learned during wars in Korea and Vietnam influenced further development of the defence of air bases. Both conflicts have many common elements in the field of aerial defence. In both conflicts, communist airbases were targeted by repeated air strikes. In turn, the air bases of dominating military forces in conflicts (in Korea - the UN bases, in Vietnam – the U.S. bases) were attacked sporadically. North Korean and Vietnamese military forces used for mainly ground anti-aircraft weapons and passive air defence measures. The North Korean military proved to be master of camouflage, deception and dispersal. Their airbase infrastructure was virtually unrecognisable from the air. At decoy air bases, damaged or destroyed aircraft were deployed in order to hide operational combat air bases. At the same time, aircraft decoys were deployed in the form of aircraft models at operational combat air bases and around

21 It was the equivalent of contemporary CRC.

22 D. Wood, D. Dempster, *Narrow Margin*, Arrow Books, London 1969, p. 312.

23 *Ibidem*, s. 65.

24 A. Gropman, *The Battle of Britain and the Principals of War*, *Aerospace Historian*, Marzec 1971, p. 142.

them. These types of actions proved to be effective and repeatedly provoked Allied air strikes, which failed²⁵.

The situation in Vietnam was similar. Passive air defence measures were used. Aircraft were deployed not only at air bases, but also at certain distances away from them. Aircraft positions were sometimes located 6-10 km from the runway and carefully masked. The North Vietnamese military often used helicopters to transport fighter planes from remote locations to airfields. The fighter aircraft on ground alert were protected by protective revetments and roofs that protected them from bomb shards. All elements of the air base infrastructure, and in particular aircraft positions, were accurately masked. The means for camouflage included handheld camouflage nets, and the equipment was covered with paint in masking colours. Mock-ups of aircraft made from handheld materials were also set²⁶.

Both the wars set new standards for the active aerial defence of air bases. The emergence of jet aircraft forced the use of new weapons in air defence. As a result, anti-aircraft missile weapons appeared next to anti-aircraft artillery. During the conflict there were around 190 launch positions for surface to air missile systems on the territory of North Vietnam. Forty of them remained on alert, the rest of them were used as reserve positions. SA-2 surface to air missile systems were used for area defence of the entire territory of North Vietnam and for point defence of important objects, including air bases. Use of the radar systems to control fighter aircraft and fire control of anti-aircraft sets became the strongest points of the air defence²⁷. In turn, the appearance of anti-aircraft missiles forced technical changes in combat aviation. While preparing for strikes against North Vietnamese air bases, the U.S. military developed special procedures for overcoming the bases' air defences. The U.S. aircraft were equipped with electronic devices warning about the radar beam emitted by fire control radar and a missile launched towards the aircraft. This allowed the pilots to use anti-missile maneuvers. The raids were carried out under the cover of electronic warfare, which also reduced the efficiency of fire control radars by reducing the accuracy of missile guidance on the target. The strike groups contained aircraft equipped with Shrike anti-radar missiles, which were used to eliminate the fire control radar and surveillance radar. The system of warning about the air attack approaching the base was therefore eliminated. New laser-guided bombs were also used, which significantly increased the precision of the strikes against air bases²⁸.

The North Vietnamese air defence forces did not remain passive and drew conclusions from their failures. They began to use tactics adequate for the weapons used by the enemy. During air strikes, the time regimes of radar transmissions were

25 J.F. Kries, *Air warfare and ...*, op. cit., p. 269.

26 A. Radomyski, *Obrona powietrzna we współczesnych konfliktach zbrojnych, Wietnam (1964-1973)*, AON 2005, p. 66.

27 B.C. Nalty, *Tactics and techniques of electronic warfare, electronic countermeasures in the air war against North Vietnam 1965-1973*, Washington 1977, p. 10-11.

28 *Ibidem* s. 87.

used, which reduced the exposure of these radars to the U.S. anti-radar missiles. The SA-2 systems were equipped with a television channel for aiming, which in good weather allowed the radiation of the fire control radar to be limited. Aircraft information for firing positions was transferred from central post control stations, which in turn eliminated the need to use local surveillance radar. Electromagnetic emissions were reduced to a minimum²⁹. The new equipment also caused changes in the passive defence of air bases. Precisely targeted bombardments forced the strengthening of air base infrastructure facilities. In order to protect aircraft from detection and damage from debris, protective structures buried in the ground were constructed. Underground reinforced aircraft shelters were made of reinforced concrete structures and also had reinforced concrete and steel sliding doors. The shelters were covered with soil and planted with grass and shrubs to form a uniform surface with the surrounding area³⁰.

Also deserving of recognition was the way in which the North Vietnamese air defence forces organised fire control of air bases defence assets. The close cooperation of fighters with anti-aircraft artillery, missile units and radiolocation units was one of the basic conditions for effective engagement of aerial threats while ensuring the safety of their own aircraft. The officers of the North Vietnamese air force cooperated closely with the anti-aircraft defence liaison officers (missile and artillery units), who informed their units about the operations of fighters and passed on data and the capabilities of their units to the commander of aviation. If the air bases were inside the missile engagement zone, the ingress and egress safe lines were designated for the fighters, in which the anti-aircraft forces did not engage any aircraft. The most complicated was the organisation of cooperation between fighter aviation and anti-aircraft missile units. The essence of this cooperation was the constant reconciliation of the way their fire interacted with individual air targets. This cooperation was carried out both in separate and shared areas of responsibility. Joint engagement of enemy aircraft in defence of air bases took place only in favourable weather conditions with the use of optical sights. In these cases, the North Vietnamese anti-aircraft artillery that defended the air base fired for the purposes indicated by the commander of the fighter regiment. If there was no time to warn the anti-aircraft forces when the fighters entered the zone, pilots entered the zone at an altitude exceeding the range of effective fire of anti-aircraft artillery³¹.

The Suez Crisis of 1956 also provided a lesson related to the importance of the aerial defence of air bases. Although strikes at the air bases were not the most important part of the military operations, they indicated a certain direction in which future military operations would follow. In order to achieve success, the first strikes in an armed conflict are directed against the enemy's air forces. The main targets of the attack are air bases to deprive the enemy of the ability to operate in the air

29 A. Radomyski, *Obrona powietrzna we ...*, op. cit., p. 89.

30 J.F. Kries, *Air warfare and ...*, op. cit., p. 269.

31 A. Radomyski, *Obrona powietrzna we...*, op. cit., p. 67.

and thus achieve the ability to operate freely in the air. During the crisis, the use of electronic warfare has deprived the Egyptian air defence forces of information about the air situation. As a result, Egyptian air forces did not attempt air combat and Egyptian aerial defence of air bases was practically ineffective. Anti-aircraft artillery fired without spectacular success. Because of the absence of aerial defence, most of Egypt's air force was destroyed on the ground at air bases³².

The Six-Day War of 1967 turned out to be a milestone in the development of concepts for offensive counter air operations, to include airfield attacks, as well as a sobering moment for those responsible for the defence of air bases. Drawing conclusions from the previous conflict, the Egyptian Air Force provided a well-functioning warning system providing alerts about aerial threats. The information was sent to the central command centre that was equipped with direct communication links with all air defence command posts. At every Egyptian air base, the MiG-21 fighter aircraft squadron was kept on air defence ground alert in the event of an air alarm. Egyptian fighters spent several hours every morning in the air, patrolling the airspace near the border with Israel. Surface to air missile units were deployed throughout the territory of the country as part of the area's air defence. Each SA-2 squadron was protected by an anti-aircraft artillery unit³³. The passive air defence measures employed by Egyptian air forces in 1967 proved insufficient. The methods of camouflage at air bases was ineffective. Decoy planes were used to deception. They put the decoys in places where normally aircraft do not stand, which made it possible from the air to recognise that they were not real combat aircraft. In addition, they forgot to make the mock-ups look more realistic by applying stains on fuels, greases and exhaust gases. Because of that, the deception efforts were not very realistic and, as a result, only a few decoy targets attracted the attention of Israeli pilots. In preparation for the confrontation, the Israeli air force command made a continual update of the plans to strike Egyptian air bases. The documentation for pilots contained target folders with the latest aerial imagery of air bases which might become targets of strikes³⁴. In accordance with the Israeli doctrinal assumptions in the period preceding the war in 1967, all knowledge and experience was focused on developing a model of massive air strikes against the enemy's air bases. According to the consistent assessment of Israeli experts, the air assets of the Arab states had to be eliminated from the actions first, and the preferred method for that was believed to be to destroy them on the ground in the first phase of the conflict. According to these assumptions, the Israeli plan of aggression assumed the execution of a massive and

32 R. Fullick, G. Powell, *Suez: the double war*, Greenhill 2006, p. 109-122.

33 C.W. Yost, *The Arab – Israeli War, how it began*, <https://www.foreignaffairs.com/articles/israel/1968-01-01/arab-israeli-war> [access: 05.04.2018].

34 J.F. Kries, *Air warfare and ...*, op. cit., p. 310.

surprising air strike against the Egyptian air bases, gaining air superiority, and then offensive land forces maneuver operations supported from the air³⁵.

To perform the first air strike, the Israelis selected ten of the most important Egyptian air bases. The intention of the Israeli Air Force Command was to quickly eliminate the Egyptian air force by destroying aircraft on the ground³⁶. It is worth noting the scope and content of preparation of Israeli pilots to perform air strikes on the enemy air bases. For this purpose, a model of the airbase (with full infrastructure and mock-ups of planes) was built, which served as a training field for Israeli pilots. Before the attack was conducted, accurate reconnaissance of the standard patrol flight of the enemy was made. In order to dampen the vigilance of air defence, Israel's aviation performed multiple training flights over the sea approaching the border with Egypt. It was about to persuade the Egyptian air defence to believe that this scheme of actions would not be transformed into combat operations at the last moment³⁷. During the bombing of air bases, Israeli aviation used new weapons dedicated to the destruction of runways and taxiways. Bombs dropped from very low altitudes (about hundred metres) penetrated runway or taxiway surfaces and then exploded inside the belt structure deep in the ground and left craters with heavily cracked concrete around them. The Israeli command assumed that the use of several such bombs on each runway would allow them to block Egyptian combat aircraft at air bases and destroy them in the next raid³⁸. By destroying two-thirds of the combat aircraft of Egypt's air force, Israel gained air superiority from the beginning of the conflict and thus assured security for its own air bases.

The Six-Day War taught a sobering lesson to air defence forces worldwide. The importance of effective air defence for air bases became evident. Both active and passive air defence measures evolved because of that in most countries around the world. Finally, the lesson was learned by the Egyptian military. In the period between 1967 and 1973, the Egyptian air force made significant efforts to improve defence of its air bases. This was also the case for the Israeli air force. The Arab side of the conflict represented by Egypt, Iraq, Syria and Jordan put emphasis on issues related to passive air defence of the air bases. This was the result of an analysis of the effectiveness of the new weapons available for strikes against air bases. In the late sixties and early seventies, new generations of anti-radar missiles and penetrating bombs, detonating after delving into the structure of the object being attacked, started to become available to numerous air forces around the world. The Arab air forces also drew realistic conclusions from the battle for air superiority during the last conflict. Concrete runways, taxiways and aircraft stands reinforced

35 A. Radomyski, *Gorące niebo nad bliskim wschodem. Obrona powietrzna w wojnach arabsko-izraelskich 1967-1982*, Toruń 2007, p. 24-25.

36 A. Radomyski, *Gorące niebo nad ...*, op. cit., p. 34.

37 W.C. Wetmore, *Israel's air punch major factor in war*, *Aviation week and space technology*, July 3, 1967, p. 20; A. Radomyski, *Gorące niebo nad ...*, op. cit., p. 26.

38 E. O'Ballance, *The Third Arab ...*, op. cit., p. 66-68.

with concrete and steel were built. Taxiways were widened so that they could be used as emergency runways, and in some air bases, additional full-size runways were built. One of the runways was in continuous use and the other one was hidden for use in the event of damage to the main runway. In order to increase the aviation's dispersal capability, sections of the motorways were prepared for use as air strips by creating roadside sections for aircraft maintenance. They also built hiding places for aircraft along motorways, which would facilitate future use of air strips³⁹. Aircraft shelters were buried in the ground and roofed with reinforced concrete. Two types of shelters were built at the air bases. Some of the shelters were recessed in the ground and camouflaged using vegetation, stones and other materials typical in the area. The second type were surface shelters that could accommodate one to two fighter aircraft. Both types had massive doors made of steel and reinforced concrete. To damage or destroy an aircraft in such a facility, it was necessary to hit the shelter directly with a heavy penetrating bomb. Tanks for storing aviation fuel were also masked and hidden under the surface of the ground. Petroleum tanks at one air base were connected by reinforced pipelines running underground. The air base infrastructure was either hidden under the surface of the earth or reinforced by special constructions reducing its ballistic vulnerability to air attacks⁴⁰.

Passive defence of air bases in Arab states during that period was supported by the centralised air defence system in the form of air defence zones based on different types of anti-aircraft systems. This resulted in an air defence system consisting of multi-layered engagement zones. On the one hand, it ensured the survival of the air defence assets, and on the other hand, it increased opportunities for engagement of air threat across a broad altitude and range spectrum⁴¹. Although such engagement zones did not constitute direct defence of the air bases, creating such area air defence zones throughout the country denied freedom of action to Israeli aviation and restricted its access to air bases in neighbouring Arab states. It is also worth noting that some of the most important air bases of the Egyptian air force located near Alexandria and Cairo were protected by SA-3 surface to air missile systems that were deployed for active point defence around the bases. The Israeli military, observing military preparations in the Arab countries and the upcoming confrontation, took actions aimed at reducing the air potential of the potential aggressor⁴². Israel's air defence was equipped with Mirage IIIC fighters armed with air to air missiles with radar or thermal guidance. Israeli aviation was based in nineteen air bases. Israel deployed its planes in such a way that there were around twenty five aircraft at every base. It should be mentioned that the Israeli air bases were as well prepared in terms of

39 J.F. Kries, *Air warfare and ...*, op. cit., p. 321.

40 E.H. Kolcum, *Soviets accelerating mildest drive*, *Aviation Week and Space Technology*, May 25, 1970, p. 14-18.

41 A. Radomyski, *Gorące niebo nad...*, op. cit., p. 52.

42 *Ibidem*, p. 320.

passive air defence as Arab installations were⁴³. To sum up the conflict, Israeli losses amounted to 15-16 aircraft. Egypt's losses were about 101-113 aircraft. Most of the aircraft losses were the result of air combat and the operations of ground based air defence systems. This period of Arab-Israeli confrontation did not include attacks against air bases and destruction of the aircraft on the ground. Apparently, the Arab side of the conflict drew conclusions from the previous conflict and the defence of air bases was sufficient to dissuade air attacks on them.

The October War (Yom Kippur) of 1973 set another milestone in the concepts of counter air operations. The conflict had seen the continuation of trends related to the progress in the field of preparing the aerial defence of air bases. The first air strikes in this conflict were against air bases. The Egyptian air force struck at Israeli air bases, focusing mainly on destroying runways and radar and navigation facilities. Beginning the retaliatory actions, Israeli air was also primarily focused on strikes against the aggressor's air bases. Forty four F-4 airplanes attacked seven Egyptian air bases first. 130 missions were flown on another day against five Syrian and two Egyptian air bases. The Israeli aviation effort during the attacks on the air bases was comparable to that performed during the Six-Day War. However, the effectiveness of the air strikes against Arab air bases was much less than expected. Arab forces were much more immune to electronic warfare. In order to make attacks on the air bases, the Israeli Air Force had to avoid the air defence engagement zones that covered Arab land forces. It was not always possible, because the air defence zones covered almost the entire territory of the combat area. Moreover, the air bases were also protected by point air defence systems. The Egyptian air force maintained air defence fighters in combat air patrols in the rear zone. Fighters which patrolled Egypt's airspace were able to intercept Israeli aircraft and defend airbases. The reinforced shelters in the air bases were excellent protection against bombs weighing 500 pounds (225 kg) and Maverick missiles. Israeli aviation managed to destroy only one such shelter during the war. Unable to destroy the aircraft hidden in the shelters, the focus was on the destruction of runways. The tactics of Israeli aviation against the runways combined the aircraft bombarding runways with assault aircraft dropping cluster bombs with incendiary charges in front of strike groups. This allowed the anti-aircraft defence of the base during the time of attacks aimed at destroying the runways to be eliminated. The effectiveness of these strikes was slight. It allowed the Israeli air force to achieve air superiority for a period of two to six hours (it took that long to repair damaged runways). Nevertheless, it was often just enough time to attack other important targets located deep in the enemy area. As a result of the attacks on the air bases, Israeli aviation managed to destroy twenty two aircraft on the ground⁴⁴. Because effective air defence was assured for air bases of Arab states, it was more effective to destroy the enemy's aircraft in the air. Because of that, the Arab air forces lost 334

43 A. Radomyski, *Gorące niebo nad ...*, op. cit., p. 52.

44 *Ibidem*, p. 166.

aircraft in combat and the Israeli air force only three in the first two weeks of 1973 war⁴⁵.

Israel's air bases were not attacked in an effective way by the aviation of the Arab countries. The well-organised air defence of Israel, directed from the central command post of the air force, effectively prevented the enemy's aviation from achieving goals in Israel itself. During the 1973 war, the Egyptian Tu-16 bombers fired about 26 Kelt anti-radar missiles at Israeli air bases. As a result of the attacks, one radar station was destroyed and one damaged. Syria also tried with new Frog-7 weapons obtained from Russia. Several of these missiles (from three to five) hit the area around the Ramat David air base in northern Israel. The warheads dug into the ground, then they exploded forming a line of funnels without causing damage to the air base infrastructure. It was probably the first use of tactical ballistic missiles against the air base. In the Jom Kippur war, Israel's air force was not able to achieve effective air attacks against enemy air bases as it was during the attacks against air bases during the June 1967 war. Several factors contributed to this, and the decisive factor was the effective air defence organised by the Arab countries. The air defence consisted of a large number of both surface to air missile systems and various anti-aircraft artillery systems. The advantage of air defence was the high density (saturation) of anti-aircraft defences for defending the selected area. An air defence system was built in a comprehensive and complementary way. Missile and artillery systems were developed in defended areas, which adequately formed a mutually complementary multi-layered fire system capable of defending against air threats at all altitudes and ranges. It may be concluded that the concentration and massing of efforts as well as the comprehensiveness of active and passive air defence measures enhanced the efficiency of the aerial defence of the air bases.

The period after the Cold War

Air operations conducted after the Cold War have been primarily distinguished by the use of advanced state of the art weapon systems by at least one side of the conflict, which de facto determined the result of the confrontation before the start of military operations⁴⁶. The first Gulf War and Operation Desert Storm may serve as a good example of this phenomenon. Iraq's air defence system looked strong if one took into account its organisation and the number of weapon systems. It was a centralised system further divided into four air defence sectors. The air bases in each of the air

⁴⁵ J.F. Kries, *Air warfare and ...*, op. cit., p. 334.

⁴⁶ This approach to US operations is described in the doctrine called the Weinberger-Powell doctrine, which shows that the two basic conditions for US military engagement are: having a devastating advantage and maximum chances of success with minimal losses. The doctrine also emphasised the important (and even decisive) role of aviation in carrying out military (war) operations.

defence sectors were protected by surface to air missile systems. As a rule, area air defence was used for defence of air bases. Iraqi air defence forces were equipped with SA-3 systems and SA-2 systems produced by the Soviet Union (with a total of 250 launchers) and anti-aircraft artillery of 75, 100 and 130 mm calibers. Iraqi air defence had 100 Mirage, 150 MiG-21 and MiG-23 and MiG-29 fighters that could be used for air defence operations. The surface to air missile systems, anti-aircraft artillery and fighters were supported by radar information from the network of radar posts operating under the centralised air defense system⁴⁷.

During Operation Desert Storm, Iraqi air defence operations were carried out in accordance with the previously developed concept of defensive operations of its own aviation in the initial period of the war. Before the beginning of the conflict, hardened air shelters were prepared in Iraqi air bases. These were hangars of reinforced concrete, underground structures and facilities hollowed out in the rocks. The aim of these passive air defence measures was to protect aviation from destruction in the first hours or days of the war. To some extent this aim was achieved. Although the Iraqi air force lost 140 aircraft, which was fewer than 25% of the initial number, the survivability rate was quite high if one compares the military potential of the sides to the conflict⁴⁸. The Iraqi air defence system proved to be ineffective against the most advanced weapon systems that were used for the attacks against air bases and other elements of the air defence system by the armed forces of the coalition states. Military operations were initiated by strikes from Tomahawk cruise missiles (fired from ships), F-117 aircraft, on-board aviation (from 6 aircraft carriers) and bomber fighter aircraft taking off mainly from Saudi Arabia and Egypt's air bases. Operations were carried out under electronic warfare. The air defence system and air bases were attacked first, as well as the command system of the armed forces and the leadership of the state⁴⁹. After four days of fighting, Iraq was deprived of air defence and Iraqi aviation and air bases were almost eliminated from the fight⁵⁰. It can be argued that the active defence of Iraqi air bases was doomed to failure. Its combat potential did not match that of the coalition partners, and it was not able to fight the numbers and oppose the technological level of coalition weapon systems⁵¹. Nevertheless, passive air defence measures used at Iraqi air bases reduced, to some extent, the effectiveness of coalition air and missile strikes and prevented total destruction of the Iraqi air force during the early hours and days of Operation Desert Storm.

Attacks on air bases were also part of NATO support for United Nations peace operations in Bosnia and Herzegovina between 1992 and 1995. As the peace operations mandate called for restriction and proportionality of international

47 W. Świątnicki, *Wojna powietrzna w obszarze Zatoki Perskiej*, AON 1991, p. 7.

48 *Ibidem*, p. 25-26.

49 *Ibidem*, p. 29.

50 M. Madej, *Wojny Zachodu*, Warszawa 2017, p. 40.

51 In the face of cruise missiles and modern aircraft F-117 air defense Iraq was completely helpless.

community response to Bosnian Serb infringements of peace agreements, the air bases were not to be attacked as a rule. During the Deny Flight and Deliberate Force operations, NATO air strikes were allowed to be carried out on those targets that posed a direct threat to NATO's aviation. The strikes were mainly conducted against Serbian ground based air defences. As for the strikes on air bases, they were seen as the last resort measure and were avoided by the UN authorities. NATO air attacks on the air base in Udbina may serve as an example of the limitations in this specific area. After obtaining the approval of the UN Security Council, NATO was authorised to perform strikes on the air base in Udbina. As part of the mission mandate, the attack was restricted to the runway and anti-aircraft facilities⁵². The runway and the radiating air defence assets of the airbase were destroyed. Neither the remaining batteries deployed in defence of the air base nor the aircraft and supporting facilities were attacked⁵³.

NATO intervention in Kosovo and Operation Allied Force in 1999 are useful example of air base defence in peace enforcement operations. The intervention was conducted using air assets, which makes it unique among military operations of that scale carried out so far. The intervening force had to take into account a threat from approximately 170 aircraft which were deployed in the military air bases of Yugoslavia, of which about 90 aircraft were assessed to be ready for combat employment. The air forces of Yugoslavia's inventory were predominantly obsolete. The Serbian Air Defence Forces were equipped with weapon systems from the 1970s. Relatively modern surface to air missile systems were available to air defence units of land forces. Although three phases of Operation Allied Force can be distinguished in the course of the operation, from the point of view of problems related to air defence of air bases, the first phase is the most important. During this period, a classic struggle for air superiority took place. The main goal of the NATO air operations was to suppress Serbia's air defence system and provide its own air operations with a certain level of security. The targets for NATO air operations in the first stage of Operation Allied Force were the air defence facilities, air bases, command posts, and anti-aircraft squadron positions. In the second stage of the operation, civilian airports were also added to the list of targets, thus rendering it impossible for military aviation to use them for any air base maneuver⁵⁴.

The current conflict in Syria confirms the thesis that air bases are still an attractive targets for fighting sides. Operations in Syria suggest that air defence of air bases should be kept at high combat readiness regime at all times to be able to take defensive action against a wide range of air threats. Russian air bases in Syria

⁵² M. Marszałek, *Użycie lotnictwa NATO w konflikcie bałkańskim 1992-1995*, Warszawa 2016, p. 172-175.

⁵³ According to the adopted assumptions, the NATO air force did not strike at those air defence assets that did not track the NATO planes (their radiolocation stations did not radiate a radar beam to NATO aircraft).

⁵⁴ M. Madej, *Wojny Zachodu*, Warszawa 2017, p. 94-95.

were attacked by primitive, “homemade” unmanned aerial vehicles, and the Syrian regime’s air bases were targeted by advanced cruise missiles. Although the Syrian air defence system possesses about nine hundred different types of anti-aircraft missiles, most of them are old and obsolete. Syrian surface to air missile systems include rather old long-range SA-5, SA-2 and SA-3 systems. The most modern anti-aircraft defence equipment in the Syrian regime’s arsenal is the Pancyr-S1 self-propelled artillery and missile system. However, its range limits its deployment to point defence. Israeli aircraft raids and attacks on ground targets in Syria (the target is Hezbollah), especially that of March 2017, show that Syrian anti-aircraft defence can easily be bypassed. Four Israeli F-16 fighters flew into Syrian airspace from the territory of Lebanon and successfully attacked the area of Palmyra with precision weapons (probably the T-4 air base). Firing SA-5 long-range missiles was symbolic and pointed to the helplessness of medium-range systems, and the reported shooting down of one of the machines is almost certainly not true⁵⁵. It is worth also mentioning several attacks by stand-off missiles on the territory of Syria, including the Mezzeh air base, which seems to be one of the best protected Syrian bases. Attacks have been performed so far by F-16 Barak (F-16C / D) or Sufa (F-16I).

Air strikes were also directed against air bases used by the Russian air force in Syria. The Russian base in Hmejmim was attacked twice by terrorists using unmanned aerial vehicles⁵⁶. Ten drones were used for the attack. They were made of laminate while the hull was a skeleton made of aluminum, plastic, wood and polystyrene, covered with tape, which constituted its shell. The drones were not remotely controlled and did not have cameras or other sensors that would allow a precise impact. All they had to do was to reach the designated geographic coordinates to deliver their combat payload. The strike was carried out from a distance of over fifty kilometres. The Russian air base in Syria was also attacked by mortar fire. As a result of the attack, eleven aircraft were believed to have been destroyed at the Chmejmim base. More than ten Russian soldiers were injured and at least two were killed⁵⁷. One of the most important factors that enabled such an effective attack on the Russian base was the complete ignorance of the principles of passive air defence associated with the dispersal of aircraft at the base. Aircraft were deployed directly on the apron, grouped wing to wing without any protective revetments. Bombs and rockets were often stored alongside aircraft. In this situation, the explosion did not damage an individual aircraft, but rather all aircraft in the range with shards. It can also not be excluded that some of the victims and losses caused by the shelling of the base was the effect of not only the missiles that fell on it, but also the secondary explosions of munitions and fuel stored there. The missiles probably caused a chain reaction, which could have been prevented by the use of basic security measures

⁵⁵ <https://www.defense24.pl/na-styku-mocarstw-obrona-przeciwlotnicza-syrii-analiza> [access: 23.06.2018].

⁵⁶ <https://www.defense24.pl/inwazja-dronow-na-rosyjskie-bazy-analiza> [access: 23.06.2018].

⁵⁷ <https://inosmi.ru/politic/20180112/241176744.html> [access: 15.01.2018].

required for the passive aerial defence of air bases and standards that should apply to air bases located just a few dozen kilometres from the front line⁵⁸.

The U.S. military also contributed to the air and missile attacks on air bases in Syria⁵⁹. The attack using Tomahawk missiles, which targeted the Szajrat base, the second largest military airport in Syria, was impressive. Two U.S. destroyers in the Mediterranean fired 59 Tomahawks. This meant that loads of twenty nine tons of explosives fell on the Syrian air base. Tomahawk missiles also hit the reinforced concrete shelters for aircraft⁶⁰. The destruction of the base was not as great as one might have imagined considering the number of missiles launched. Some shelters remained intact, just like the runway, which was strewn with shrapnel, but essentially undamaged. Similarly, some Su-22 aircraft, deployed in shelters, were not destroyed. Some aircraft that were destroyed could have been inoperable. The Pentagon officially admitted that the U.S. strikes tried to avoid losses among the base personnel, which is why the attack was carried out in the middle of the night, and the Russian side was informed about it. This pre-warning (and thus indirectly for the Syrian side) –possibly allowed for a partial evacuation of people and equipment from the area threatened by the potential attack. On the other hand, the exclusion from the attack of a certain base zone, where there was a risk of serious human losses (including Russians), could have rendered the attack less effective. US President Donald Trump said that „the reason why you do not attack the runways is that you can fix them easily and cheaply”. You cannot uncritically agree with this thesis. The more so because the U.S. military possesses specialist weapons dedicated to destroying runways. The problem is that such bombs must be dropped from aircraft. The U.S. military, on the other hand, did not want to take the risk of flying manned aircraft into the Russian anti-aircraft missile zone and decided to attack with cruise missiles. It can be presumed that the air strike against the Syrian regime’s air base was rather a warning, giving a demonstration of the capabilities that may be expected if there is any re-use of chemical weapons.

Conclusions

An air base is a very lucrative target for air strikes and, at the same time, an extremely important facility that enables own forces air operations. At the beginning of World War I, few aviation commanders were aware of this dependence. The appearance of the plane, and then its constant modernisation and transformation into a military tool of destruction turned airspace into an arena for active combat operations. The

⁵⁸ <https://www.kommersant.ru/doc/3514249> [access: 23.06.2018].

⁵⁹ <https://www.defense24.pl/usa-atakuje-syrie-trump-nie-ma-watpliwosci-ze-asad-uzyl-broni-chemicznej-wideo> [access: 23.06.2018].

⁶⁰ <http://wyborcza.pl/7,75399,21614619,dlaczego-amerykanie-nie-zniszczyli-pasow-w-bazie-asada.html> [access: 23.06.2018].

dynamic development of aviation since World War I has contributed its increased importance in combat operations, and this in turn has affected the aerial defence of the air base infrastructure. The first air bases did not have organic measures and means for their air defence. This was due to the fact that strikes on airfields were not profitable from a military point of view and did not cause serious losses. This low air threat resulted from the limited range of aircraft at that time and the possibility of them carrying only small bomb loads. Along with the progress in aviation, aircraft had an increasing load and range, which in turn translated into their more frequent use for air strikes on objects located in the rear of an enemy's territory, including its air bases.

The World War II era aerial operations forced all fighting sides to invest in radar technology for air defence. Access to information about an opponent's air attack allowing for early warning has become necessary for the effective aerial defence of air bases and other critical assets. During the Battle of Britain in 1940, the radar air picture was a key element of air defence. As a result, on the basis of experience gained in the application of radar, commanders of air forces developed procedures for overcoming air defence. This, in turn, triggered air defence to change its tactics. The aim of this mutual rivalry was to achieve freedom of action in the airspace. By the end of World War II, the commanders had already realised how important the ability to operate freely in the third dimension was and to provide aerial defence for air bases. The simultaneous development of IFF transponders and better communication devices allowed for air defence to be achieved in a coherent and coordinated manner. The ability to detect and distinguish (friend or foe) aircraft in the air reduced the ability of combat aircraft to fight against ground air defences. At the same time, the pre-war ideas that anti-aircraft artillery were the basis for such defence ceased to be true. These theories have been replaced by integrated operations of ground based air defences and fighter aviation. Active aerial defence of air bases was supported by such passive measures at air bases as camouflage (deception and concealment), dispersal and reconstruction of combat readiness after aerial attacks.

The jet combat aircraft, which started being employed in large numbers after 1945, changed the tactics of air strikes against air bases and influenced the defence of those bases. Air forces started being equipped with fast jet-powered aircraft armed with specialist weapons dedicated to particular types of tasks (destruction of fortified structures, radar stations, combat aircraft etc.). Defensive weapons developed in the same way. The evolution of anti-aircraft defence led to the emergence of guided surface to air missile systems capable of engaging aerial targets. At the same time, the costs of such weapons and associated control systems increased. Technical personnel had to be well trained to be able to use new weapons efficiently. The implementation of modern technologies in the military had a direct impact on the way offensive and defensive air operations were conducted. It is worth noting that during the Cold War period, it was possible to observe how the dynamic development of air defence affected the aerial defence of air bases. An excellent example could be the Middle East, where Soviet anti-aircraft systems, passing baptism, inflicted losses on the Israeli air forces. During the Six-Day War in 1967, and in 1982 over Lebanon,

the Arab air defence systems were easy to suppress with relatively small losses. However, in 1970, during the “war of attrition”, ground based air defences were able to seriously hamper Israeli air operations after deployment of SA-3 systems. In turn, during the Yom Kippur War in 1973, SA-6 SAMs were used for the first time. As a result, Israeli aircraft crews lost air superiority and their army comrades had to fight for some time without air support. This situation can be compared to today’s activities related to the use of the anti-access area denial concept. The use of modern weapon systems (aircraft, electronic warfare, UAV) nowadays and in the nearest future does not guarantee the success of combat operations. We can deal with a similar situation today by taking into account the anti-aircraft defence systems deployed in the Kaliningrad Oblast. If we look at the security of air bases through the lens of the currently ongoing conflict in Syria, we can be sure that aerial defence of airfields is indeed indispensable, because these assets ensure air operations.

Historical experiences bring a valuable element of practical experience, interesting material for comparisons, analyses and conclusions to modern studies of war. Out of all types of strikes directed against aircraft dislocated on the ground at air bases in the time interval from 1940 to 1999, ninety one percent were the result of air attacks. The purpose of two thirds of the air strikes on airbases in that period was the destruction of the enemy’s aircraft on the ground. From the point of view of air defence, the kind of weapon that the opponent uses against a protected asset is also important. Conclusions from armed conflicts show that mostly „standoff” weapons have been used to attack air bases. Lessons learned from the history of armed conflicts, as well as current conflicts, clearly indicate that the aerial defence of air bases is an important element of military air operations. It directly affects the freedom of action in the airspace - an important condition in achieving success in combat. The manner of conducting air defence should be adapted to the current air threats, the capabilities of the armed forces and the environmental conditions in which the activities are carried out. Speaking about the historical aspects of the aerial defence of air bases, the words of Waclaw Pytkowski: *„History as a magister vitae should not give patterns - its task is to teach understanding phenomena to avoid mistakes”* may serve as guidance⁶¹.

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⁶¹ W. Pytkowski, Organizacja badań i ocena prac naukowych, PWN, Warszawa 1981, s. 34.

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