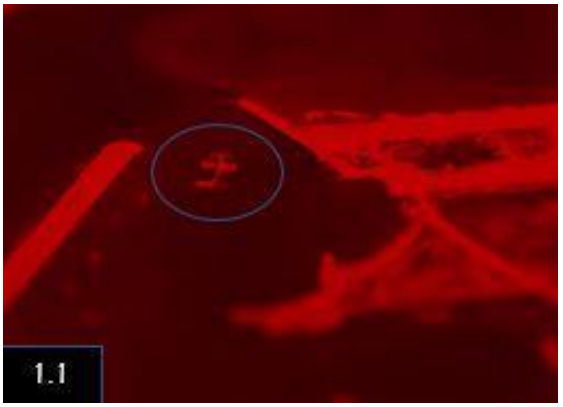
The Kaspian Monster – Monstrul Caspian

Dodi Mircea Ovidiu
Colegiul Național „Gheorghe Roșca Codreanu”, Strada Nicolae Bălcescu 11, Bârlad, Județul Vaslui, 11th Grade.

1. First appearance

In 1966, images of an unprecedented aircraft type appear on the film reels of American spy satellites monitoring the USSR. It is almost 100 meters in length but has a wingspan that is too small to fly like ordinary aeroplanes.



After studying the images (such as 1.1), the aircraft, considerably larger than any other at that time, moves at speeds comparable to those of conventional aircraft. At the height of the Cold War, the offices of intelligence agencies were set on fire by this discovery. What was in those images, though?

Well, the mysterious vehicle was the "Korabl Maket" (KM) (image 1.2), the culmination of a program that began years ago.

Due to its size, the Americans nickname it "The Kaspian Monster", codenamed KM.

2. The beginning

The story begins in 1958. Rostislav Evgenievich Alexeyev, director and chief designer of the USSR Hydrofoil Bureau, comes up with a new idea: what would it be like to have the wings, originally placed under the hull, mounted on top? Thus, a new type of vehicle is born: the ekranoplan. Today, this category is called GEV (Ground Effect Vehicle) or WIG (Wing In Ground effect).

But how does the ekranoplan work?

Initially floating like an ordinary boat, once it reaches a certain speed, due to the lift offered by the wings, the ekranoplan will completely rise from the water. Located in the air, at a low altitude, the craft enjoys the lower air resistance offered by air, as well as the help of the ground effect (which we will discuss soon), thanks to which it can carry huge weights at previously unimaginable speeds.

However, Evghenievich needs funds to see his plans realized. Being a citizen of the USSR during the Cold War, the surest source of funding is the Soviet military budget. The leadership is particularly impressed by the military potential of the project and its advantages such as cost, invisibility to sonar, water mines and radar.

The capacity of this vehicle is impressive; 304 tons, taking off with a total weight of 544 tons. It even held the record for the largest vehicle capable of flying, until 1988. To reach a cruising speed of 560 km / h (maximum 700km / h according to some sources), the KM used only 2 of its 10 engines.

3. Design elements that favour the ground effect.

What is the ground effect?

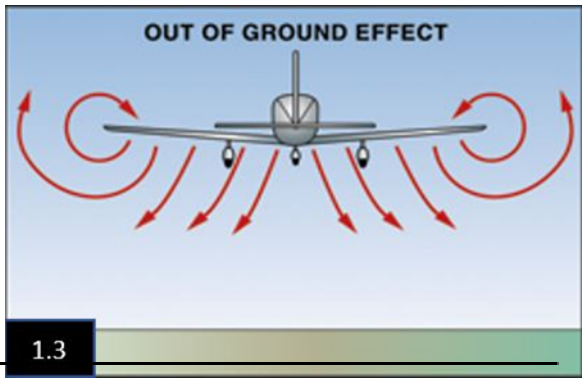
From the beginning of aviation, the pilots reported that at low altitudes they feel a particularly high force that lifts the plane. This force is due to the ground effect due to the compression of air vortices formed by the aircraft near the ground, at altitudes lower than the wingspan.

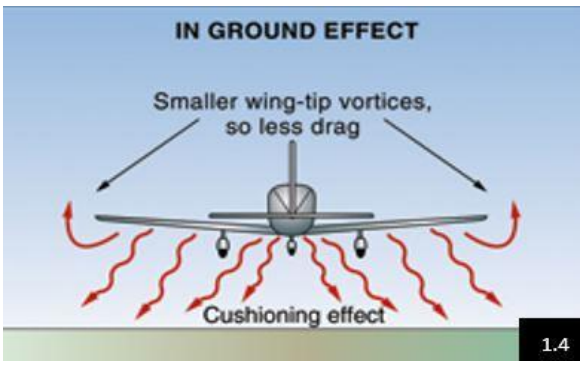
But what are vortices?

Vortices are disturbances in the fluid environment left behind by a moving object. In this case, the vortices are generated by the pressure difference between below and above the wings. This difference, due to the specific shape of the wings and their angle of attack, in turn, causes the force known as the lift - the upward force that keeps aircraft in flight. Given this pressure difference, the normal tendency of the air is to equal it, it "escaping" from the area of high pressure under the wings to the area of lower pressure above. This phenomenon is also known as "spillage".

Vortices cause induced forward resistance, which adds to the forward strength of the aircraft shape. The more intense these vortices are, the stronger the total resistance to advance and the more inefficient the flight.

During normal flight, out of ground effect, vortices are formed as illustrated in images 1.3 and 1.3.2...



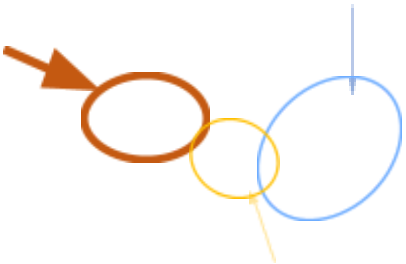


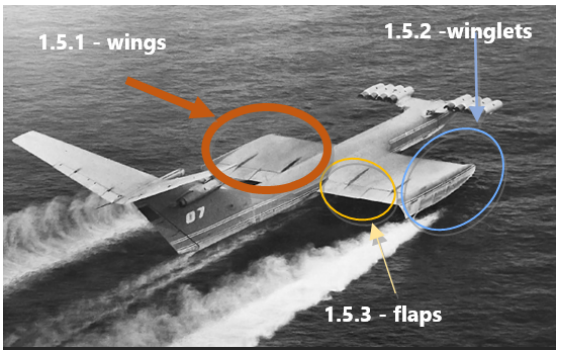
The proximity to the ground causes the compression of the vortices and implicitly their reduction. Therefore, the forward resistance is significantly reduced and the bearing capacity significantly increased; they make the flight under the action of the extremely advantageous ground effect.

For the ekranoplan to reach its maximum potential, its construction must maximize the benefits of the ground effect.

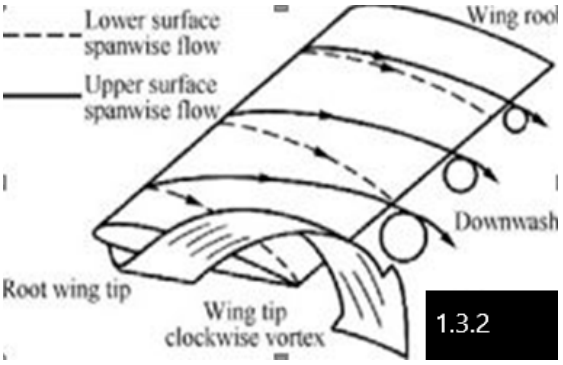
First of all, KM has a pair of wings with a very large area, with a wingspan of 37.6 meters (1.5.1) which increases the load-bearing value required to lift heavy loads.

During takeoff, the wings are aided by huge flaps (1.5.3), which provide the temporary extra load needed to detach from the water surface.



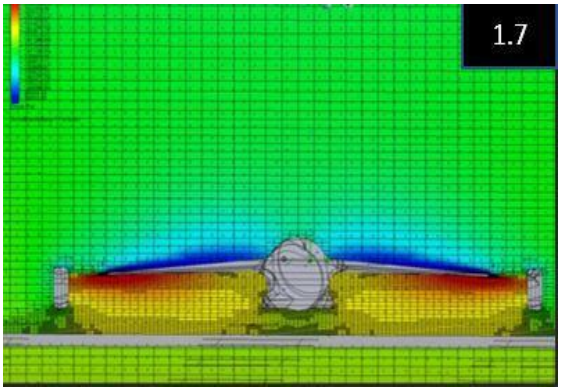


The floats at the end of the wings (1.5.2) serve several roles. First, they support the wings when KM is in the water



Secondly, they act as winglets (elements that reduce the vortices created by the tips of the wings), as well as endplates, maintaining the orderly flow of air, free of turbulence and attenuating the effect of "spillage", causing vortices thus resistance to advance.

Also, the 8 front engines are positioned so that the generated airflow flows under the wings. This airflow, kept in the lower area of the float, with high pressure, will intensify the ground effect. However, these engines are only needed for the takeoff stage. In total, the 10 engines are capable of 1275 KN force, comparable to a Boeing 747. The effect of the airflow produced by the front engines is visible in image 1.6 below:

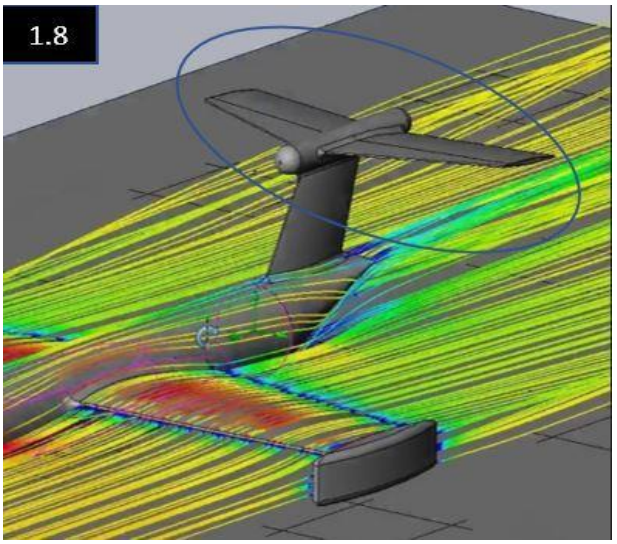


Given its dependence on flying close to the sea surface, the KM is considered a flying boat. The fact that

it bore the insignia of the Navy, and not of the Air Force, totally baffle American agencies.

To easily visualize the air pressures around the fuselage, we will use CFD simulations, visible in images 1.7 and 1.8.

The normal pressure zones are coloured green, the low-pressure zones blue and the high-pressure zones yellow and red. Another vital construction element is the rudder – the vertical stabilizer. To be effective, it must be placed in an area with no turbulent air. In the case of such a large aircraft, which leaves a considerable mass of turbulent air behind it (wake), it must have a considerable height (in our case, 21.8 meters). The vertical stabilizers, shown in image 1.8, which need the same conditions, are mounted, unconventionally, at the upper end of the rudder.



However, an ekranoplan also had many practical inconveniences, such as reliability, the need for perfect flight conditions and very difficult handling.

KM had such a wide turning radius that it needed ships placed along the route to confirm passage safety.

4. The beginning of the end

In 1964, the leadership of the USSR changed. Brezhnev sees the program as an unnecessary cost and cuts from the allocated funds. KM sustained several flights but in 1980 suffered a severe accident. Other ekranoplan models such as Lun, a mobile missile platform or Orlyonok, capable of landing on the ground have seen limited use in the military. In the absence of funds, the ekranoplans remained the prey of time and rust in the following years.

There have been attempts to revive the ekranoplan in the form of other GEVs, but have not seen widespread use. At the end of the 2nd millennium, Boeing promised "Pelican", which would have been larger than KM's. Unfortunately, it never sailed away.

However, it is not known what the future holds. Maybe we'll see a Pacific Monster or Mediterranean Monster.

Bibliography: Komissarov, S. (2002). Russia's ekranoplans: the Caspian Sea monster and other Wig craft. Midland.