THE PREVENTION OF STALL AIRCRAFT ON APPROACH AND LANDING BY AVIONICS MEANS

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Modern aircraft are required to have a stall warning system to tell the pilot when he is approaching a stall.

The stalling risks of the aircraft during approach and landing are accompanied by dangerous factors that lead to critical flight conditions of the aircraft during low altitudes and low speeds.

Prevention of critical flight modes requires the presence of avionics systems onboard the aircraft, which provide the crew with alarms about approaching the maximum permissible flight parameters, and in some cases make adjustments to the aircraft control system.

Risk factors leading to a stall during approach and landing are:

- critical angles of attack (AOA);
- losing true airspeed (TAS);
- excess the landing vertical speed (V_{SL});
- critical roll angles (AOR);
- excess landing weight (LW);
- nose-up moment (M_{ZT}) by engines;
- the influence of weather conditions.

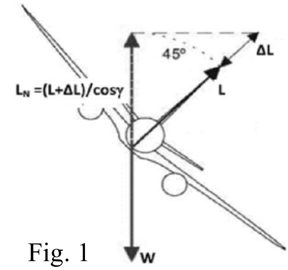

Fig. 1

Fig. 1. The increasing of the lift

Decreasing the lift to a level that is less than the weight of the aircraft leads to a loss of height, and a sharp decrease in the lift leads to the stall of the aircraft. Therefore, one of the main dangers for the aircraft is to decrease the lift and stall of the aircraft due to loss of speed or increase of the angle of attack above its critical value.

The loss of true airspeed (TAS) during approach and landing will lead to a loss of lift and control torques, and as a result, the aircraft becomes uncontrollable and stalls.

Exceeding the vertical speed (V_{SL}) leads to a loss height of the aircraft at the levelling stage, resulting in touching the ground before the runway or the aircraft will be to the critical angle of attack at the decrease of the vertical speed.

Critical roll angles (γ) influence aircraft lift during landing. During the bank, the lift (L) is divided as the horizontal (HL) and the vertical one (VL), which compensates the weight of the aircraft. Therefore, it is necessary to increase the lift to avoid a stall. For example, with the roll angle $\gamma = 45°$ the lift should be increased 1.41 times to height stabilize (Fig. 1).

The excess of landing weight during landing results in an increase in the estimated stall speed (V_{SR}) accordingly the minimum landing speed (V_{MCL}) should also be increased. This factor is important for landing an aircraft after a long flight where the aircraft weight may decrease 1,2-1,7 times (Fig. 2).

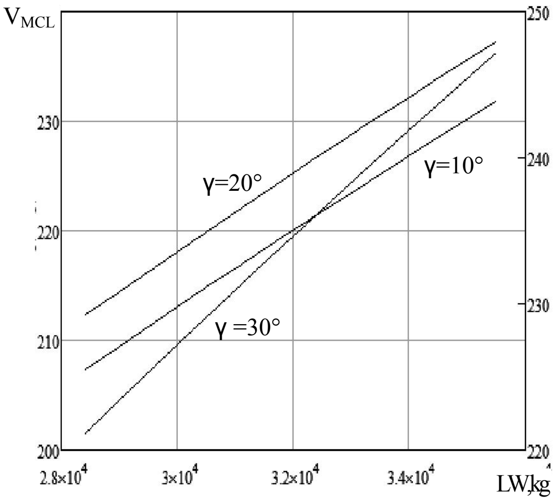

Fig. 2. Dependence of the landing speed of aircraft on the roll angle (γ) and the landing weight (LW).

During go-around to the second approach with unsuccessful landing, the engines of the aircraft create maximum thrust in a short time. A fast thrust increase in aircraft engines with lower placing on the wing can cause an increase in the critical angles of attack. In this case, in addition to the current angle of attack that is needed for the climb is the added angle of attack set up by an engine's nose-up moment (M_{ZT}). This leads to an excess of the critical angle of attack accordingly, the loss of control and loss of height, which increases the stall speed.

Almost all the risks that lead to the crash of the aircraft during the approach and landing are associated with a critical angle of attack and the minimum speed range. Therefore, constant monitoring of the minimum landing speed and the stall speed is required to eliminate these risks.

Thus, the use of the signalling of the approach to the minimum speed (V_{MCL}) as a function of the angle of attack, roll angle and landing weight of the aircraft will increase the attention of pilots to the aerodynamic characteristics at low speeds, which will help to improve the safety of aircraft landing.

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