

Combined static and fatigue tests of the full-scale structure of a transport aircraft

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In connection with the development of a new modification of the Il-76 transport aircraft, it became necessary to experimentally confirm the static strength of the wing design, as well as fatigue life of the wing, engine suspension and main landing gear of the modified Il-76MD-90A aircraft. To carry out the necessary tests, non-conventional approach was applied, which consisted in combining static and fatigue tests at one airplane.

The test object included:

- a) a full-scale wing on which pylons for the PS-90A engine with dummy engine were installed, flap rails with dummy carriage;
- b) middle part of the fuselage with installed wing - fuselage fairings;
- c) main landing gears with dummy wheels.

Test were carried out on a special setup (Fig.1), which provided loading by the limit load to the wing, as well as cyclic loading by flight cycles "at height" and "near the ground". When testing for static strength, the right wing console was loaded to the limit load, the left was loaded to the maximum loads during fatigue tests. During the fatigue testing, the wing, the flaps rails, the engine suspension, the middle part of the fuselage, the main landing gears were cyclic loaded. To balance the active loads, which simulated the aerodynamic and inertial loads in the flight, the setup provides special loading channels that prevent the movement of the aircraft as a whole. At the same time with cyclic loading the fuselage was pressurized.



Figure 1. Full scale static-fatigue test set up.

Tests were accompanied by stress-strain analyses by the finite element method. The results of calculations were compared with results of measuring. The obtained stresses from the limit loads were extrapolated to the ultimate loads.

To justify the calculated criteria of static strength and buckling of the compressed wing panels, tests were carried out before the destruction of structurally similar samples of full-scale panels from the critical zones of the structure.

The applied approach to the static and fatigue tests allowed to significantly reduce the cost of their carrying, as well as to reduce the duration of the work cycle.

Keywords: full-scale fatigue test, static test, transports aircraft, buckling.