The study of Tu-160 design improvement using modern materials

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Background. The study raises the topic of the use of modern composite materials in aviation industry. The idea of installing a composite wing of large elongation on Tu-160 was proposed, its scheme was developed, a 3D model of the aircraft and both wing variants were created. Calculations were carried out predicting an increase in Tu-160 flight range due to the modernization.

Aim. Development of a long-extension wing variant for Tu-160 and calculation of an increase in flight range.

Methods. In Compass-3D computer-aided design system, a Tu-160 model was created on a scale of 1:1000. The 3D model provided for the creation of separate elements as part of the assembly: a central titanium beam-caisson (center section) with wing rotation nodes, detachable wing parts, "ridges" and fairings. Flying Bear Ghost 5 3D printer has a 1:50 scale model of Tu-160 made of PLA and PETG plastics. The dimensions of the resulting model are108 cm in length and 110 cm in maximum span. The model retains the possibility of shifting the detachable part of the wing into all three flight configurations, rotation of the crests is provided.

By analogy with a large elongation wing made of modern carbon fiber composites used on MS-21, a scheme for determining the wing elongation for Tu-160 (without taking into account the integral part) for cruising flight mode is constructed. In the printed model of the aircraft, it is possible to change the wing of the usual extension to a promising wing of increased extension, for this an appropriate set of "black" wings is made. The creation of the model was necessary for further calculations.

Results. The wing extension on Tu-160 in the cruising position is 8.44 in accordance with the formula $\lambda = l^2/s$, where λ is the wing elongation, l is the span, s is the wing area in plan.

The elongation of the new version of the detachable part of the wing according to the calculations is 10.85.

According to the calculations the new wing area in plan (excluding the integral part) equals 323,53 m^2. The increase in the area of the elongated wing relative to the original [1] is 18,9 m^2. The volume of the caisson of the original wing is 16,86 m^3, elongated wing — 21,23 m^3. The difference is equal to 4,37 m^3, 5% of which is occupied by internal structural elements. The calculated additional volume of one enlarged wing caisson can be 4,15 m^3. According to these data, an increase in flight range was calculated.

Conclusions. Based on these data, Tu-160 missile carrier with the latest NK-32–02 engines [2] and a composite wing of large elongation can have a maximum flight range of 14890 km (+12,8%) without refueling.

Keywords: supersonic missile carrier; wing extension; 3D model; composite materials; 3D printing; flight range.

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