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A New Approach in a Problem of a Supersonic Panel Flutter

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Abstract : On the example of an elastic rectangular plate streamlined by a supersonic gas flow, we have investigated the phenomenon of divergence and of panel flatter of the overrunning of the gas flow at a free edge under assumption of the presence of concentrated inertial masses and moments at the free edge. We applied a new approach of finding of solution of these problems, which was developed based on the algorithm for an analytical solution finding. This algorithm is easy to use for theoretical studies for the wides circle of nonconservative problems of linear elastic stability. We have established the relation between the characteristics of natural vibrations of the plate and velocity of the streamlining gas flow, which enables one to draw some conclusions on the stability of disturbed motion of the plate depending on the parameters of the system plate-flow. Its solution shows that either the divergence or the localized divergence and the flutter instability are possible. The regions of the stability and instability in space of parameters of the problem are identified. We have investigated the dynamic behavior of the disturbed motion of the panel near the boundaries of region of the stability. The safe and dangerous boundaries of region of the stability are found. The transition through safe boundary of the region of the stability leads to the divergence or localized divergence arising in the vicinity of free edge of the rectangular plate. The transition through dangerous boundary of the region of the stability leads to the panel flutter. The deformations arising at the flutter are more dangerous to the skin of the modern aircrafts and rockets resulting to the loss of the strength and appearance of the fatigue cracks.

Keywords : stability, elastic plate, divergence, localized divergence, supersonic panels flutter
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