

STAND WITH ARTIFICIAL AIRFLOW SIMULATION AND FLUTTER TESTS RESULTS OF DYNAMICALLY SCALED MODEL

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Wind tunnel (WT) testing of models is one of the most important tools of flutter research. Special dynamically scaled models (DSM) are required in order to conduct tests. Development of DSM is time-consuming and WT tests are very expensive process.

DSM testing on the special bench – before WT test - is additional tool for flutter research. In this case forces generated by DSM oscillation in the real airstream are reproduced.

Aerodynamic forces simulation is performed using the method of electromechanical modeling (EMM). Accelerometers convert mechanical vibrations into electric signal (“inputs”), then special computer unit (SCU) generates, based on some aerodynamic theory, electric signals (“outputs”) proportional to the calculated aerodynamic forces. Finally, output signals are transferred to force exciters which generate mechanical forces acting on DSM.

If scaling coefficients are chosen correctly and there is no delay in the processing of input signals, ratio between inertial, elastic and aerodynamic forces will be the same as at WT airflow.

No delay requirement leads to usage of SCU and modal exciters instead of personal computers and shakers. The amplitude of the oscillations in the artificial stream does not exceed the permissible level thanks to the electronic limitation device. This prevents the destruction of expensive model and provides the possibility of its further use for tests in wind tunnel.

Designed stand made it possible to study flutter boundaries and DSM vibrations at subcritical flows. A number of aerodynamic theories were used during tests.

Unlike WT testing there is no constraints in the range of simulated flow regimes. It is possible to test a wide range of speed, Mach number and air density values.

Duration of the measurements in the simulated stream is restricted only by operator’s labor-time, so there are no limits existing at WT testing – such as launch cost and limited duration of continuous work.

Experimental results obtained during tests showed satisfactory agreement with the calculations.