5-10 knot range very little trend is seen; both the port and starboard vortices appear to be dissipating at the same rate, even though one vortex is translating faster than wind and the other is translating slower than wind. In winds above 10 knots B-737 and DC-9 vortices were observed to decay quickly (in about 10 sec.).

## References

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# Aeroelastic Stability and Control of an Oblique Wing: Wind Tunnel Experiments

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AEROELASTIC stability and control of an oblique wing has proved to be a conceptually difficult problem. Intuitively, one expects the forward panel of the oblique wing to behave as a conventional swept forward wing panel. If this were the case, then the oblique-winged airplane would suffer a loss of aileron control and aeroelastic divergence at a relatively low value of the dymanic pressure.

A more careful theoretical analysis, by the author and J. W. Nisbet of the Boeing Company, which includes freedom of the aircraft fuselage in roll shows that the behavior of the oblique wing is different from that of swept forward wings. The analysis shows that the oblique wing does not have the divergent instability of the swept forward wing but can be operated safely at much higher dynamic pressures. Moreover the aileron control, which would show singular behavior on approaching the dynamic pressure for divergence of the swept forward wing, remains effective according to this theory up to considerably higher values of the dynamic pressure. If $q^*$ is the dynamic pressure for divergence with the fuselage fixed in roll and $q$ is the dynamic pressure for instability with the fuselage free then the ratio $q/q^*$ may be shown to depend on the mass distribution and inertia of the wing in relation to the moment of inertia of the fuselage about its roll axis. The predicted form of instability is a bending oscillation of the wing coupled with oscillatory rolling motion of the fuselage.

These predictions of the theory have now been verified in wind tunnel tests of an elastic wing model made by Dennis W. Riddle and Peter Gaspers at NASA-Ames Research Center. Figures 1 and 2 show the model installed in the 7′ × 10′ wind tunnel of the U. S. Army Air Mobility Laboratory at Ames. These experiments will be covered more completely in a later report.

The model wing has an elliptic planform of 10 to 1 axis ratio and a symmetrical airfoil section of 7-1/2% thickness/chord ratio. The wing is of wood and as may be seen in the photographs, slack wires were used to limit the amplitude of unstable motions. The fuselage was mounted on bearings permitting freedom in roll, but provision was made to clamp the fuselage for some of the tests. The ailerons were actuated remotely by a Craft radio control unit of the type used by RC model flyers.

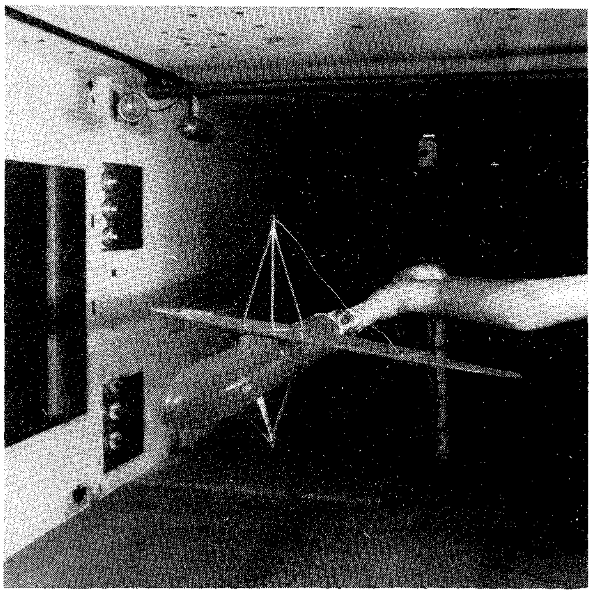

Fig. 1 Aeroelastic model in 7 ft × 10 ft wind tunnel.

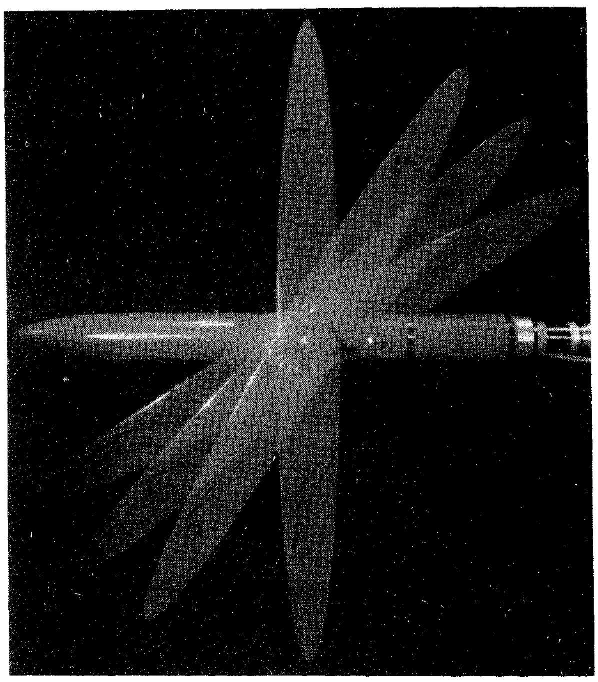

Fig. 2 Plan view of aeroelastic model.

With the fuselage clamped and the model at a fixed positive angle of attack the upward deflection of the wing increased progressively with increasing airspeed. By extrapolating the deflection curve of the forward wing panel, it was determined that static divergence would occur at a speed of approximately 225 fps. The divergence speed was nearly the same at 45° and 60° yaw. With the model free in roll and with ailerons activated to maintain trim the model developed unstable bending-rolling oscillations at a speed of 275 fps again at either 45° or 60° yaw. Thus, freedom in roll increased the dynamic pressure at which aeroelastic instability first appeared by approximately 50%, in rough agreement with the behavior predicted by our analytical model. With the model free in roll, the effectiveness of the ailerons in maintaining trim was not noticeably affected by passage through the speed at which the wing would have become unstable if clamped.

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