when $V_d = V$, which occurs when $\frac{\partial C_L}{\partial \xi} = \frac{\left(\frac{\partial C_{m,0}}{\partial \xi}\right)}{e}$ then the aileron is completely effective at all speeds. Such a situation arises.

Introduction to flutter

We have previously defined flutter as the dynamic instability of an elastic body in an airstream. It is found most frequently in aircraft structures subjected to large aerodynamic loads such as wings, tail units and control surfaces.

Flutter occurs at a critical or flutter speed V_f which in turn is defined as the lowest airspeed at which a given structure will oscillate with sustained simple harmonic motion. Flight at speeds below and above the flutter speed represents conditions of stable and unstable structural oscillation, respectively.

Generally, an elastic system having just one degree of freedom cannot be unstable unless some mechanical characteristic exists such as a negative spring force or a negative damping force. However, it is possible for systems with two or more degrees of freedom to be unstable without possessing unusual characteristi

The flutter of a wing in which the flexural and torsional modes are coupled is an important example of this Type of instability.

Some indication of the physical nature of wing-bending-Torsion-flutter may be had from an examination of aerodynamic and inertia forces during a combined bending and Torsional oscillation, in which the individual motions are 90° out of phase.

The Type of flutter described above in which two distinctly different Types of osillating motion interact such that the resultant motion is divergent is Known as clasical flutter.

Other Types of flutter non-clasical flutter may involve only one Type of motion, for example stalling flutter of a wing occurs at a high incidence where for particular motion of the spanwise axis of twist. Self exited Twisting osillations occur in critical speed.

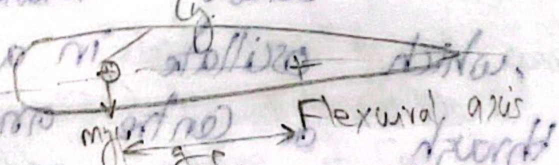
Other non classical form of flutter aileron buzz occurs at high subsonic speeds is associated with the shock wave on the wing forward of the aileron.

Buffeting is produced most commonly in a tail plane by eddies caused by poor airflow on the wing wake striking the tailplane at a frequency equal to its natural frequency a resonant oscillation having one degree of freedom could then occur. The problem may be alleviated by proper positioning of the tailplane and clean aerodynamic design.

Coupling :-

We have seen that the classical flutter of an aircraft wing involves the interaction of flexural and Torsional motions. Separately neither motion will cause flutter but together at critical values of amplitude and phase angle the forces produced by one motion excite the other two types of motion are then said to be coupled various forms of coupling occur, inertial aerodynamic and elastic.

For example, the cross section of a small length of wing is shown in fig.



Its centre of gravity is a distance gc ahead of its flexural axis; c is the wing section chord and the mass of the small length of wing is m. If the length of wing is subjected to an upward acceleration $\ddot{y}$ an accompanying inertia force $m\ddot{y}$ acts at its centre of gravity in a downward direction thereby