producing a nose down torque about the flexural axis of $m\ddot{y}gc$, causing the wing to twist. The vertical motion therefore induces a twisting motion by virtue of the inertia forces present i.e. inertial coupling. Conversely an angular acceleration $\ddot{\alpha}$ about the flexural axis causes a linear acceleration of $g c\ddot{\alpha}$ at the centre of gravity with a corresponding inertia force of $mgc\ddot{\alpha}$

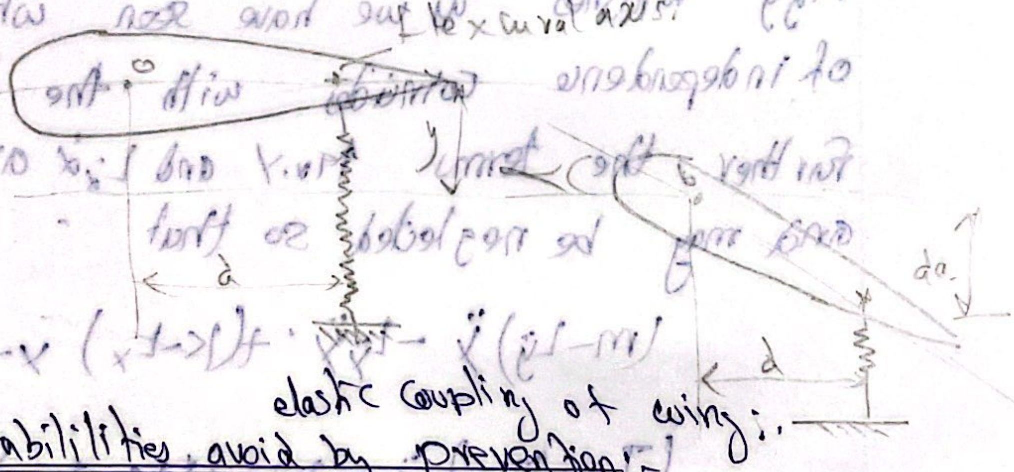
Thus, angular acceleration generates a force producing translation again inertial coupling. Note that the inertia torque due to unit linear acceleration (mgc) is equal to the inertia force due to unit angular acceleration $(mg\ddot{c})$. The inertial coupling therefore possesses symmetry.

Aerodynamic Coupling:-

Aerodynamic coupling is associated with changes of lift produced by wing rotation or translation. A change of wing incidence, that is a rotation of the wing induces a change of lift which cause translation while a translation of velocity $\dot{x}$ say results in an effective change in incidence, thereby yielding a lift which causes rotation. These aerodynamic forces which oscillate in a flutter condition, act through a centre analogous to the aerodynamic centre of a wing in steady motion this centre is known as the centre of independence.

Consider now the wing section and suppose that the wing stiffness is represented by a spring of stiffness K

positioned at its flexural axis. suppose also that the displacement of the wing is defined by the vertical deflection y of an arbitrary point o. and a rotation α about O. The vertical displacement produces a spring force which causes a clockwise torque $k_y d$ on the wing section about O resulting in an increase in wing incidence α. The clockwise rotation α about O results in a spring force $kd\alpha$ acting in an upward direction on the wing section, thereby producing translations in the positive y direction. Thus, translation and rotation are coupled by virtue of the elastic stiffness of the wing, hence elastic coupling, we note that as in the case of inertial coupling, elastic coupling possesses symmetry since the moment due to unit displacement (kd) is equal to the force produced by the unit rotation (kd) Also if the arbitrarily chosen point O is made to coincide with the flexural axis, $d=0$ and the coupling disappears.



elastic coupling of wing:

Instabilities avoid by prevention:-

From the above it can be seen that flutter will be prevented by coupling the two constituent motions. Thus inertial coupling is prevented if the centre of gravity coincides with the flexural axis, while aerodynamic coupling is eliminated when the centre of independence coincides with the flexural axis.