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ANALYTICAL AND EXPERIMENTAL DYNAMIC ANALYSIS OF A CANTILEVER WING

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ABSTRACT

This study deals with the determination of a cantilever wing dynamic response characteristics including natural frequencies, natural modes, nodal lines and damping in each vibration mode. An experimental and theoritical investigation has been made. The experimental analysis is based on the single point excitation technique which is shown to give reasonably accurate results for lightly damped structures. In the theoritical analysis, a rough approximate solution is firstly obtained by considering the wing as a beam. Secondly finite element and lumped masses techniques are used. Finite element method yields superior results very close to the experimental ones. Also an extension to the case of a cantilever wing carrying a concentrated mass has been treated.

1. INTRODUCTION

Since a long time the problem of mechanical vibration of aircraft wing was the subject of many studies. An aircraft wing is normally subjected to inertial, elastic and aerodynamic forces. The coupling between these three types of forces yields to either of the folloiwng studies: Static stability; Elastic and aerodynamic forces. Dynamic stability; Aerodynamic and inertia forces Mechanical vibration; Inertia and elastic forces, which is the problem treated in this study. Aeroelastic vibration, the three types of forces.

2. BASIC EQUATIONS

For the research purpose, a cantilever wing uniform in the span and chord wise directions has been manufactured. It has a standard airfoil section NACA 63_2-015.

For small amplitude, the equations of motion representing the transverse vibration of the cantilever wing can be represented by the following two partial differential equations [1]:

$$(EI\, w'')'' + mw'' + md\ddot{\theta} = 0 \qquad (1.a)$$

and $$-(GJ\theta')' + md\ddot{w} + J_o\ddot{\theta} = 0 \qquad (1.b)$$

where $(\prime) = \partial/\partial x$ and $(\cdot)^{\cdot} = \partial/\partial t$

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