DESIGN OF AN ADAPTIVE DYNAMIC VIBRATION ABSORBER

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Thesis submitted for the degree of

Master of Engineering Science on the 21st April, 1999.

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Notation

m_a = mass of absorber or secondary structure (kg)

m_b = mass of base or primary structure (kg)

ω_a = natural frequency of absorber (rad/s)

$\omega_{b,}$ ω_n = natural frequency of base (rad/s)

$\omega_{11,}$ ω_{22} = first and second modes of the composite system (rad/s)

p = excitation or operating frequency (rad/s)

E = modulus of elasticity (Pa)

I = second moment of inertia (m^4)

ρ = density (kg/m^3)

H_a = impedance of absorber (N/m/s)

H_b = impedance of base (N/m/s)

u_b = maximum displacement of base with absorber attached (m)

u_F = maximum displacement of base without absorber attached (m)

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ABSTRACT

The aim of this thesis is to investigate the use of a Dynamic Vibration Absorber to control vibration in a beam. Traditional means of vibration control have involved the use of passive and more recently, active methods. This study is different in that it involves an adaptive component in the design of vibration absorber using two novel designs for the adaptive mechanism.

The first design incorporates the use of an enclosed air volume to provide the variable stiffness component in the absorber. By adjusting the volume of compressible air within the absorber, the stiffness characteristics of the absorber can be altered, enabling the device to adapt to changing vibration frequencies. Work here includes a theoretical investigation of the device. Following this, two prototypes are constructed and tested, the second of which is the refined model used for further testing.

The second design incorporates the use of two concentrated masses cantilevered from two rods. The adaptive solution is achieved by moving the two masses along the length of the rod, producing a changing natural frequency for the absorber device. An analytical model of this device is developed as well as a finite element model. Results from both are compared to those obtained experimentally.

Finally, a tuning algorithm is derived for the second absorber, and a control system constructed to make the dynamic vibration absorber “adaptive”. Experiments are undertaken to determine the effectiveness of the absorber on the beam subject to changing excitation frequencies. The outcome of this research is that an Adaptive Vibration Absorber has been constructed with a computer interface such that the device can be used “on line”.

STATEMENT OF ORIGINALITY

This thesis does not contain any material which has been accepted for the award of any degree or diploma in this university or other tertiary institution. Unless where stated or referenced, this work contains no material which has been previously published or written by other researchers.

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Signed:…………………………….. Date:……………………

ACKNOWLEDGMENTS

The author would like to thank Dr. Scott D Snyder for his supervision and input, and his willingness to support the ideas forwarded in the research.

Thanks must also go to Dr. Colin H. Hansen for his interest and comments in the discussion of the work. The study would never have been possible without the talents and suggestions from George Osborne, Silvio De Ieso, Alan Mittler and Derek Franklin.

The author would also like to thank Ron Jager, Craig Price and Malcolm Bethune for all their work in the construction of the absorbers.

Finally, a big thank you to all the administration staff in the department of mechanical engineering, and my fellow cubicle peers, and also in particular, Benny B. Cazzolato, for much of his intelligent input.