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USE OF A DYNAMIC ABSORBER IN THE CASE OF A VIBRATING PRINTED CIRCUIT BOARD OF COMPLICATED BOUNDARY SHAPE

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1. INTRODUCTION

A large number of electronic systems are subjected to severe vibrational levels caused by operational requirements. Accordingly, the knowledge of natural frequencies and mode shapes of printed circuit boards (PCBs) is of interest in a great variety of technological situations.

Traditionally, PCBs mostly have been rectangular or circular and supported around the boundary either continuously or at a discrete number of points [1]. But as stated by Steinberg [2]: "Growing use of electronics in unusual, new applications is bringing new challenges to packaging design. Cylindrical housings may require a circular PCB, others may need triangular or hexagonal shaped PCB's". It is important to predict natural frequencies of these elements, since resonance conditions can cause harmful effects. "Connectors work loose, component leads snap and the board may even crack".

Simply supported and clamped polygonal plates carrying concentrated masses have been considered in previous investigations [3, 4].

The present study deals with an experimental investigation on the feasibility of using a dynamic absorber when a PCB of complicated boundary shape† operates under resonance conditions, see Figure 1.

2. EXPERIMENTAL SET-UP AND INVESTIGATION

A regular hexagonal steel, plate clamped along the boundary has been used, see Figure 1. Its dimensions are "a" (plate side) = 290 mm and "h" (plate thickness) = 3·17 mm. The fundamental frequency of the plate (without tuning the dynamic absorber of mass "M") was equal to 112·7 Hz. The plate was excited at resonance using a commercial loudspeaker and then the dynamic absorber of mass "M" = 25 g was tuned by modifying its position along a threaded rod of length "L" = 40 mm and diameter "D" = 3·7 mm.

† A clamped, hexagonal plate is used.

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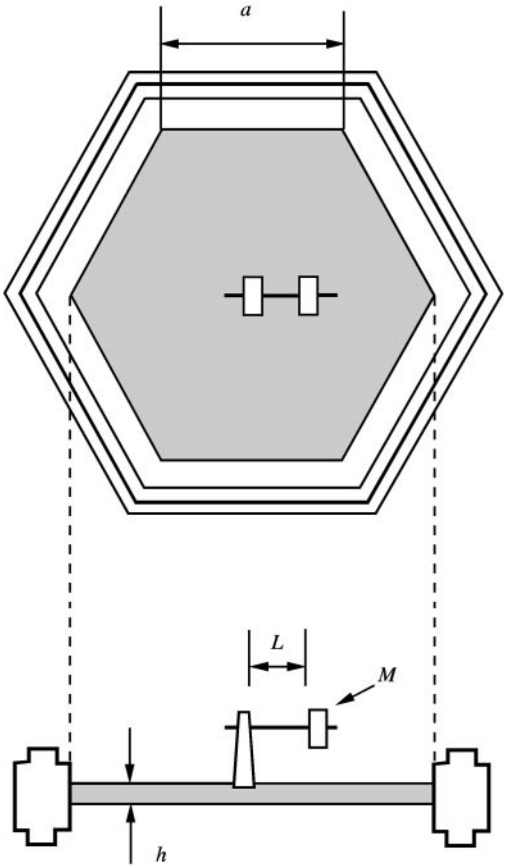

Figure 1. Clamped regular polygonal plate of side "a" and thickness "h" with an attached dynamic absorber of mass M

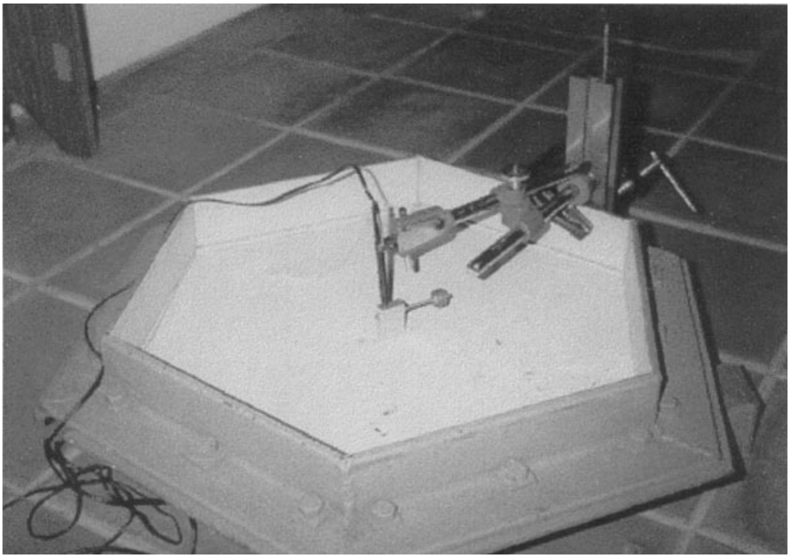

Figure 2. Experimental set-up.

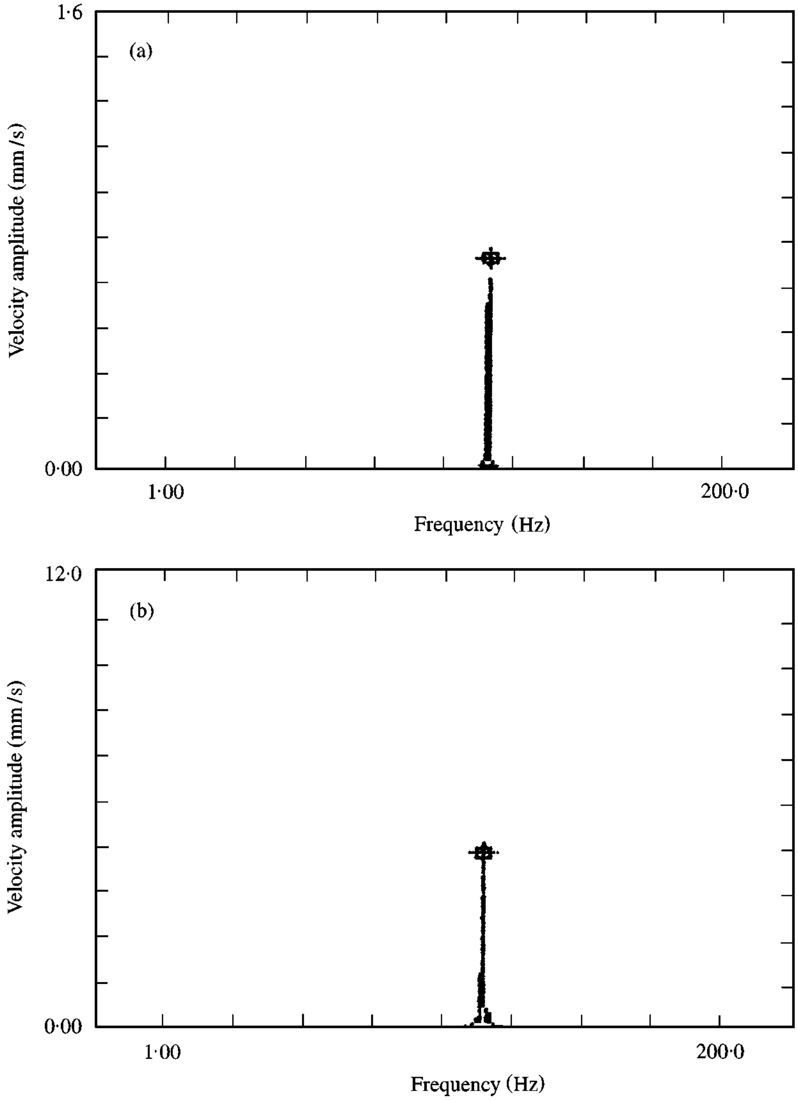

Figure 3. Vibrational levels of the plate: (a) before placing the dynamic absorber; (b) once the dynamic absorber is tuned.

Figure 2 shows the experimental set-up used in the present investigation. The IMA infrared transducer [5] was used, greatly facilitating the task of tuning the dynamic absorber since the transducer does not require physical contact with the vibrating element under investigation. Figure 3 depicts the dynamic response of the hexagonal plate: (a) before placing the dynamic absorber and (b) once the tuning operation has been performed. As expected: the plate velocity amplitude experiences a highly noticeable decrement: from 4·697 to 0·7367 mm/s.

The approach is also applicable in the case of large size plates as used in civil and naval engineering systems when dealing with structural elements of complicated boundary shape.

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