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INVESTIGATION OF VIBRATIONS OF PLATE TYPE ELEMENTS OF AGRICULTURAL TRANSPORTATION DEVICES

In the process of operation of agricultural transportation devices it is important to avoid resonance vibrations of their cases. In this paper investigation of vibrations of plane usually upper and lower surfaces which are of plate type of those devices is performed. By using powder material on the horizontal surfaces of those devices it is possible to obtain various distributions of powder type material and from them one can determine the shape of the excited eigenmode of vibrations. Experimental investigations are performed and their results are presented.
Key words: *transportation device, case of the device, plate type element, resonant vibrations, eigenmodes of vibrations.*

1. Introduction

In the process of operation of agricultural transportation devices it is important to avoid resonance vibrations of their cases. In this paper investigation of vibrations of plane usually upper and lower surfaces which are of plate type of those devices is performed.

By using powder material on the horizontal surfaces of those devices it is possible to obtain various distributions of powder type material and from them one can determine the shape of the excited eigenmode of vibrations. Experimental investigations are performed and their results are presented.

Investigations are based on the material related with analysis of dynamics and vibrations which is presented in [1] – [8].

2. Investigation of vibrations of plate type elements of agricultural transportation devices

A square plate excited in the center is investigated. Powder material is located on the surface of the plate. In the process of vibrations from the image formed by the powder material on the surface of the plate one can determine which eigenmode of vibrations is being excited.

Typical experimental image is presented in Fig. 1.

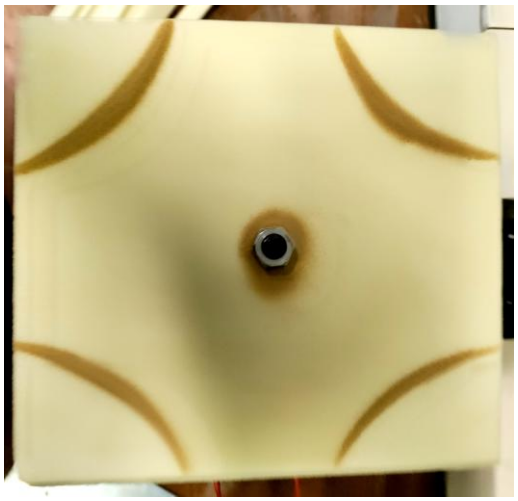

Fig. 1. Experimental investigation of vibrations with application of powder type material

Eigenmodes of bending vibrations of a square plate fastened at the center point are investigated. Results are presented by images with intensity assumed as:

$$I = \cos^2\left(2\pi\frac{w}{\lambda}\right), \quad (1)$$

where w is the transverse displacement of the plate and λ is the constant which determines the density of intensity fringes.

The first eigenmode is represented in Fig. 2.



Fig. 2. The first eigenmode

The second eigenmode is represented in Fig. 3.



Fig. 3. The second eigenmode

The third eigenmode is represented in Fig. 4.



Fig. 4. The third eigenmode

The fourth eigenmode is represented in Fig. 5.

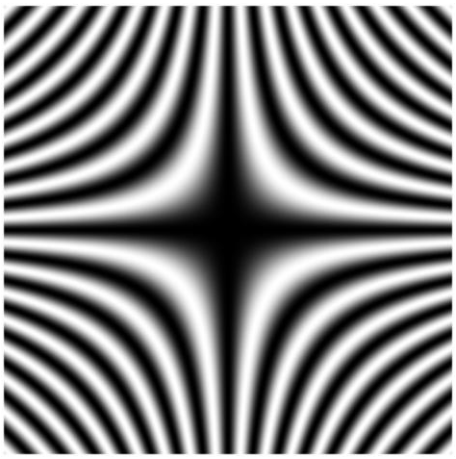

Fig. 5. The fourth eigenmode

The fifth eigenmode is represented in Fig. 6.

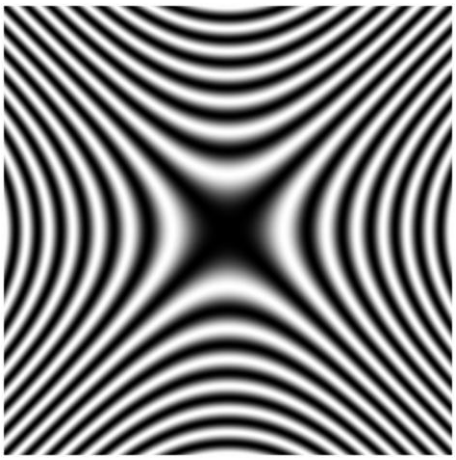

Fig. 6. The fifth eigenmode

The sixth eigenmode is represented in Fig. 7.

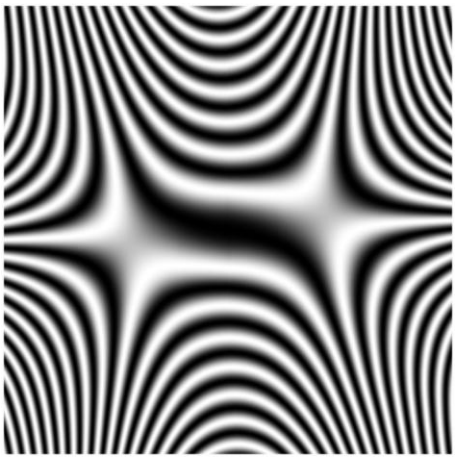

Fig. 7. The sixth eigenmode

The seventh eigenmode is represented in Fig. 8.

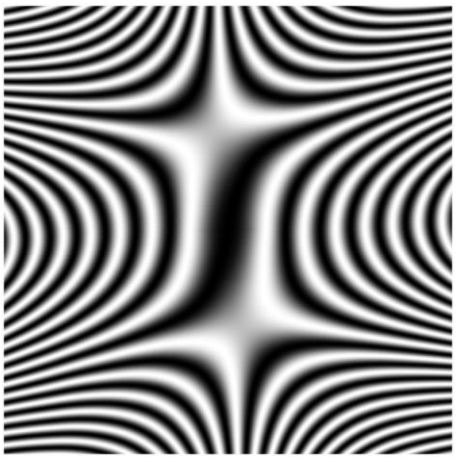

Fig. 8. The seventh eigenmode

The eighth eigenmode is represented in Fig. 9.



Fig. 9. The eighth eigenmode

The ninth eigenmode is represented in Fig. 10.

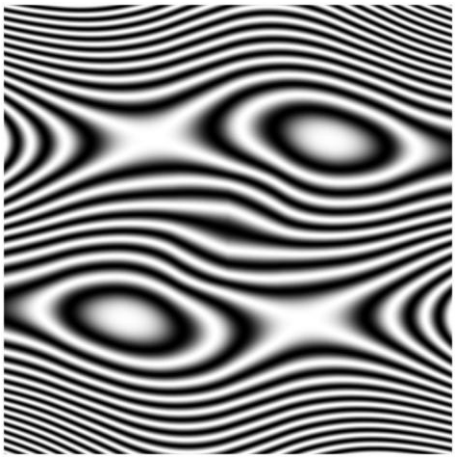

Fig. 10. The ninth eigenmode

The first and the second eigenmodes correspond to the same eigenfrequency. The sixth and the seventh eigenmodes also correspond to the same frequency. This is because of the symmetric qualities of the plate type structure and linear combinations of multiple eigenmodes are also eigenmodes, that's why they produce not necessarily symmetrically looking results.

From the presented results it is possible to determine that the fourth eigenmode was observed in the Figure 1. The advantages of application of powder type materials for investigation of bending vibrations of horizontal plate type structures are simplicity and easy applicability of the method.

3. Conclusions

By using powder material on the horizontal surfaces of agricultural transportation devices it is possible to obtain various distributions of powder type material on the investigated surfaces. A square plate excited in the center is investigated. Powder material is located on the surface of the plate. In the process of vibrations from the image formed by the powder material on the surface of the plate one can determine which eigenmode of vibrations is being excited.

Eigenmodes of bending vibrations of a square plate fastened at the center point are investigated. The first and the second eigenmodes correspond to the same eigenfrequency. The sixth and the seventh eigenmodes also correspond to the same frequency. From the presented results it is possible to determine which eigenmode was observed in the experimental image using powder type material.

The advantages of application of powder type materials for investigation of bending vibrations of horizontal plate type structures are simplicity and easy applicability of the method.

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