CASE ANALYSIS: SPEED OF SOUND AS A FUNCTION OF THE CHARACTERISTICS OF GEOMETRIC PROPAGATION MEDIUM

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ABSTRACT: This paper presents two distinct aspects:

The theoretical part where some of the bases are highlighted theory of sonics, science falsely passed into obscurity, although the 60's was compared to the known work of Einstein. Some practical part, where is proposed a practical method for measuring the speed of propagation of mechanical energy through the medium considered a electrical long line. The conclusion from this analysis of the case: the speed of propagation of mechanical energy through a material medium considered a electrical long lines depends on the geometry of the environment and can take values lower or higher than the value stated in the table for that environment.

KEY WORDS: theory of sonics.

Consider an elastic spring (Fig. 1) which, with a simple experimental device, we can measure the values of:

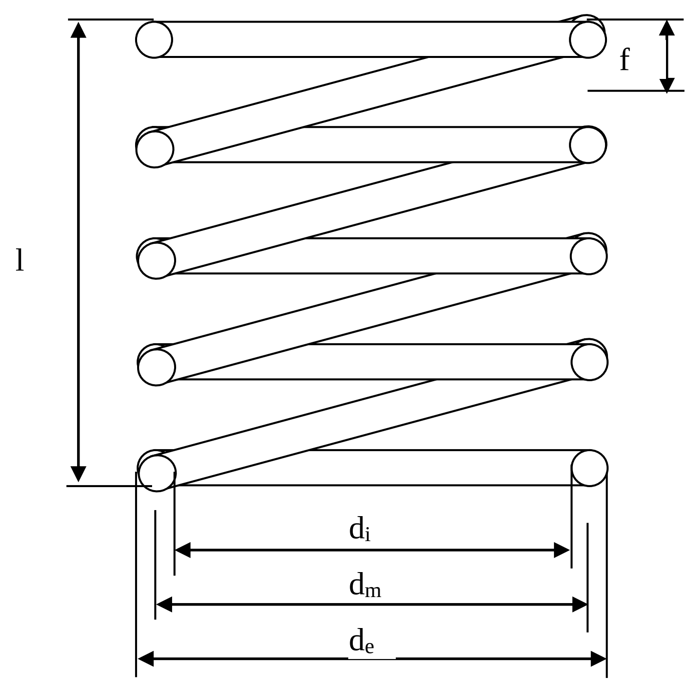

Fig 1

- The length of spring 1 [m];
- External diameter d_e [m];
- The internal diameter d_i, [m];
- Mean diameter $d_m = \frac{d_i + d_e}{2}$ [m], by means of which calculates the resort section $\omega = \frac{1}{4}\pi d_m^2$
- Spring mass M [kg].

• The spring is pressed with different values Gi weights and measure changes in spring length, denoted as f_i.
• Calculate the mean values G of Gi and the mean values f of f_i.
• The measured values are substituted into formulas sonic capacity C and sonic inductance L [1] so that we can get the numeric values of sonic average sizes:

$$\mathbf{C = \frac{f\omega^2}{G}} \quad \text{şi} \quad \mathbf{L = \frac{M}{\omega^2}}$$

• By dividing sonic C and L values for the spring length to obtain the values of sonic distributed per unit length;

$$\underline{C} = \frac{C}{l}; \ \underline{L} = \frac{L}{l}$$

• With their help one can determine the value of the propagation velocity of mechanical energy through the resort:

$$v = \frac{l}{\sqrt{\underline{L}\underline{C}}}$$

By involving numerical values measured in relation thus obtained, and using the calculation steps (•), we obtain:

$l = 57\cdot10^{-3}$m; $d_e = 35\cdot10^{-3}$m;

$d_i = 29\cdot10^{-3}$m; $d_m = 32\cdot10^{-3}$m;

$\omega = 804\cdot10^{-6}\text{m}^2$; $M = 41{,}2\cdot10^{-3}$kg; $G = 247\cdot10^{-3}$N; and corresponding,

$f = 4{,}9\cdot10^{-3}$m;

$C = 12831{,}53\cdot10^{-12} \frac{m^4 s^2}{kg}$;

$\underline{C} = 225{,}11\cdot10^{-9} \frac{m^3 s^2}{kg}$;

$L = 63696 \frac{kg}{m^4}$;

$\underline{L} = 1117{,}47\cdot10^3 \frac{kg}{m^5}$;

by means of which it is determined:

$v \cong 20 \frac{m}{s}$;

$$[v] = \frac{1}{\sqrt{\frac{m^3 \cdot s^2}{kg} \cdot \frac{kg}{m^5}}} = \frac{m}{s}$$

thus confirming the relationship and dimensional check.

It is known that the speed of sound in steel is about $5\cdot10^3$m/s, which is considered constant material.

Analyzing the result, $v = 20$ m/s for elastic spring in relation to the steel $v_s \sim 5000$ m/s (value accepted as a material constant) we are led to the following conclusions:

• speed of sound can be considered "material constant" only for an infinite dimensional.

• speed of sound depends on the geometry of a finite dimensional material environment, or in other words, by changing the geometric shape of a material change propagation speed of mechanical energy.

Mathematical formalism used is specific electromagnetic energy propagation, but adapted to the propagation of mechanical energy.

The conclusion is that by the long line, it can change the speed of propagation of the electromagnetic energy by modifying the geometry of the long line.

References

1. Theory of Sonics, Academic Press, Bucuresti 1985.