WAVE DISTRIBUTION IN STERGIN UNDER THE LIGHT OF LONGING FOCE

Butunov Jakhangir Ruzikulovich

Tashkent region Chirchik state

Teacher of the Institute of Pedagogy

ABSTRACT

When an external force acts on an elastic body, waves propagate through the body. This paper discusses the equation of longitudinal wave propagation in a body under the action of a longitudinal force on a clamped elastic rod and its solution. This solution is of great importance today, as waves generated by many forces on elastic bodies can cause the body to rapidly collapse, crack, and break.

Keywords: Longitudinal wave, the effect of external forces on elastic bodies, wave propagation, wave propagation in rods.

ANNOTATSIYA

Elastik jismlarga tashqi kuch ta’sir qilganda jism bo’ylab to’lqinlar tarqaladi. Bu maqolada qistirib mahkamlangan elastic sterjinga bo’ylama kuch ta’sir qilganda jismda hosil bo’ladigan bo’ylama to’lqin tarqalishi tenglamasi va uning yechimi qaralgan. Bu yechim hozirgi kunda juda katta ahamiyatga ega bo’lib, elastic jismlarga ko’plab kuchlarning tasiri dahosil bo’lgan to’lqinlar jismni tezda yemirilish, yorilish va sinishga olib kelishi mumkin.

Kalit so‘zlar: Bo’ylama to’lqin, elastic jismlarga tashqi kuch ta’siri, to’lqin tarqalishi, sterjinlarda to’lqin tarqalishi.

INTRODUCTION

When an elastic force acts on an elastic body, various waves propagate through the elastic body, which is not noticeable to us. This paper presents the equation of the longitudinal wave propagation that occurs in a body when a longitudinal force acts on a clamped elastic rod and its solution. The rate of propagation of elastic waves in solids depends on the density and elastic properties of the medium. When elastic waves propagate in the medium, mechanical compression or shear deformations occur, which are transmitted by the wave from one point in the medium to another. Thus, when an elastic body is under the influence of external forces, it has the ability to restore its shape and size on its own after stopping its action. Longitudinal and transverse waves can propagate uniformly in an isotropic solid medium.

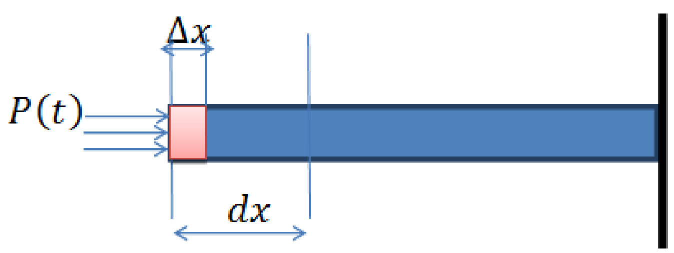
REFERENCES AND METHODOLOGY

The effects of external forces on objects have been described in many literatures. However, it is not widely studied today because the wave propagation in elastic bodies under the influence of external forces is not significant, it is difficult to solve the wave propagation equation. [1] in the literature [1], [2], the wave propagation equation are derived using the formulas of the theory of elasticity and many facts about their motion are given.

RESULTS

Calculation of the propagation rate of a longitudinal elastic wave in a solid body in order to come up with the formula, we

We derive a formula for calculating the velocity of propagation of a longitudinal elastic wave in a rigid body. Suppose that the longitudinal stress P acts on the end of an elastic rod with a cross-sectional area S of time(t). Under the influence of this voltage, the particles of the last layer Δx move away. The resulting compression deformation is transmitted from layer to layer, forming a longitudinal compression wave that propagates along the rod at time dt and travels a distance dx.



$$P(t) = \begin{cases} P(t), & if\ \ t \leq \tau \\ 0, & if\ \ t > \tau \end{cases}$$

The speed (wavelength) of a wave is v:

$$v = \frac{dx}{dt}. \quad (1)$$

The velocity u of the rod particles is equal to:

$$u = \frac{\Delta x}{dt}. \quad (2)$$

If we write Hooke's law, which represents the deformation of elastic rods:

$$P(t) = E\varepsilon = E\frac{\Delta x}{dx} = E\frac{\partial W}{\partial x}. \quad (3)$$

Here is E-Yung module.

We know the tension and the cross- sectional area of the rod.

So, using these, we find the force of elasticity by the following formula:

$$F_{el} = P(t) \cdot S = E \cdot \varepsilon \cdot S. \quad (4)$$

According to Newton's third law, the modulus of external force is equal to the modulus of elastic force.

The external force is equal to the product of the longitudinal force F acting on the impulse dP and the period τ of the action.

$$dP = F \cdot \tau = P(t) \cdot S \cdot \tau = E \cdot \varepsilon \cdot S \cdot \tau = E \cdot \frac{\Delta x}{dx} \cdot S \cdot \tau. \quad (5)$$

As we know from the course of mechanical mechanics, the following equation holds if a mass object under the action of a force impulse acquires a velocity u:

$$dP = mu = \rho \cdot S \cdot dx \cdot u = \rho \cdot S \cdot dx \cdot \frac{\Delta x}{\tau}. \quad (6)$$

Where m is the mass of the layer under consideration. Density of .ρ-stein.

So we equate (5) and (6):

$$E \cdot \frac{\Delta x}{dx} \cdot S \cdot \tau = \rho \cdot S \cdot dx \cdot \frac{\Delta x}{\tau}$$

$$\frac{E}{\rho} = \left(\frac{dx}{\tau}\right)^2 = v^2 \quad v = \sqrt{\frac{E}{\rho}}. \quad (7)$$

(5) we put (1) and (2) in the formula:

$$P(t) \cdot \tau = E \cdot \varepsilon \cdot \tau = E \cdot \frac{\Delta x}{dx} \cdot \tau = E \cdot \tau \frac{u \cdot dt}{v \cdot dt}$$

$$u = \frac{P(t) \cdot v}{E} = \frac{P(t) \cdot \sqrt{\frac{E}{\rho}}}{E} = \frac{P(t)}{\sqrt{E \cdot \rho}}; \quad (8)$$

According to the theory of elasticity, if we write the equation of motion of a binding medium, for a homogeneous rod, it is as follows:

$$\rho \frac{\partial^2 w}{\partial t^2} = \frac{\partial P(t)}{\partial x}. \quad (9)$$

It this case, the $w(x, t)$ function. $\frac{\partial \ \ w}{\partial t} = u$, so $\frac{\partial \ \ w}{\partial t} = u$ is appropriate. Integrating both sides of this equation by x:

$$m \frac{\partial \ \ u}{\partial t} = P(t) \quad (10)$$

So if we subtract (8) from (10):

$$\frac{m}{\sqrt{E \cdot \rho}} \frac{\partial \ \ P(t)}{\partial t} = P(t) \quad (11)$$

We have a differential equation. We integrate this differential equation:

$$P(t) = P_0 e^{\frac{t\sqrt{E \cdot \rho}}{m}} \quad (12)$$

We have a soluition. Now let's put (3) in (8):

$$\rho \frac{\partial^2 w}{\partial t^2} = E \frac{\partial^2 w}{\partial x^2} \qquad \frac{\partial^2 w}{\partial t^2} = \frac{E}{\rho} \cdot \frac{\partial^2 w}{\partial x^2} \qquad \frac{\partial^2 w}{\partial t^2} = v^2 \cdot \frac{\partial^2 w}{\partial x^2}. \quad (13)$$

The second-order, homogeneous differential equation (narrow oscillation equation) is formed.

So there are several ways to solve the narrow oscillation equation. We solve the problem using the Dalamber method. We need two initial conditioner to solve the initial conditions by putting $\Delta x = w(x, t)$ in formula (5):

$$P(t) = E\varepsilon = E \frac{w(x,t)}{dx} \quad w(x, t) = \int_0^x \frac{P(t) dx}{E}$$

$$w(x,t) = \frac{P(t)\cdot x}{E} = \frac{P_0 e^{\frac{t\sqrt{E\cdot\rho}}{m}}\cdot x}{E}.\; w(x,0) = \frac{P_0\cdot x}{E} = \varphi_0(x). \quad (14)$$

$$\left.\frac{dw(x.t)}{dt}\right|_{t=0} = \frac{P_0}{\sqrt{E\cdot\rho}} = \varphi_1(x). \quad (15)$$

We solve the narrow oscillation equation (13) using the initial condition (14) and (15) in the Dalamber method. Let's write the Dalember formula know from the course of mathematical physics equations:

$$w(x.t) = \frac{1}{2}[\varphi_0(x+v\cdot t) + \varphi_0(x-v\cdot t)] + \frac{1}{2\cdot v}\int_{x-v\cdot t}^{x+v\cdot t}\varphi_1(\varepsilon)\,d\varepsilon$$

We calculate the know functions $\varphi_0(x)$,$\varphi_1(x)$ by:

$$w(x.t) = \frac{1}{2}\left[\frac{P_0\cdot(x+vt)}{E} + \frac{P_0\cdot(x-vt)}{E}\right] + \frac{1}{2\cdot v}\int_{x-v\cdot t}^{x+v\cdot t}\frac{P_0}{\sqrt{E\cdot\rho}\cdot}d\varepsilon$$

$$w(x.t) = \frac{P_0\cdot x}{E} + \frac{P_0}{2\cdot v\sqrt{E\cdot\rho}}[x+v\cdot t - x + v\cdot t] + c$$

$$w(x.t) = \frac{P_0\cdot x}{E} + \frac{P_0\cdot t}{\sqrt{E\cdot\rho}} + c$$

CONCLUSION

In this paper, the longitudinal wave propagation equation generated in a body under the action of a longitudinal force is applied to help a clamped elastic rod and its solution was found in the Dalamber method, one of the ways to solve the wave propagation equation.

REFERENCES

1. Тимошенко С.П., Гудьер Дж. Теория упругости, 1975
2. Теория упругости: основные положения : учеб. пособие / В. В. Стружанов, Н. В. Бурмашева ; М-во науки и высш. образования Рос. Федерации, Урал.федер. ун-т. — Екатеринбург : Изд-во Урал.ун-та, 2019. — 204 с.
3. Новацкий В. Теория упругости, 1975