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FREE VIRATIONS OF ELASTIC MECHANICAL SYSTEMS OF THE FIRST AND SECOND TYPES

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Annotation. We will consider elastic mechanical systems (EMS) of the following types: the simplest EMS; the first type EMS; the second type EMS.

The EMS is called the simplest if its elastic subsystem consists only of springs.

The EMS is called the first type EMS, if its elastic system consists of elastic rods. This model is useful for studying vibrations of building structures, as well as of a lot of machines and mechanisms.

The EMS is called the second type EMS, if its elastic subsystem consists of absolutely rigid rods and springs. It is used in the study of structures containing elastic ties and supports (springs, bumpers, etc.).

Let's introduce some more definitions.

Vibrations of an elastic mechanical system is called forced if it is created by external variable active forces. Otherwise, vibrations of the system is called free.

Relevance. We first consider an elastic mechanical system of the first type with one degree of freedom *q* (Fig. 1). When the material point *M* moves, the reaction ***R*** is acting on it from the side of the bar system. We compose the basic equation of dynamics:

$$ma = R \tag{1}$$

(*m* is the mass of the material point *M*) and project it on the axis of the generalized coordinate *q*:

$$m\ddot{q} = -R \tag{2}$$

Since we consider only linearly elastic systems, the magnitude of the elastic reaction is proportional to the displacement of the point from the equilibrium position, i.e. generalized coordinate *q* [1-2]:

$$R = Kq \tag{3}$$

The proportionality coefficient K between the reaction of the elastic system and the displacement of the material point of the mechanical system with ODF from the equilibrium position is called the stiffness coefficient. To find K, we proceed as follows: we apply at the point M the force $P_1 = 1$

directed along the axis of the generalized coordinate q. The displacement of the point M from the action of a unit force applied at this point and directed in the positive direction of the axis of the generalized coordinate q, is called the coefficient of influence and is denoted by q_{11}. Then from the proportionality of force and displacement we get

$$1 = Kq_{11} \tag{4}$$

whence it follows that:

$$K = 1 / q_{11} \tag{5}$$

Substituting (5) into (2), we obtain:

$$m\ddot{q} + Kq = 0 \tag{6}$$

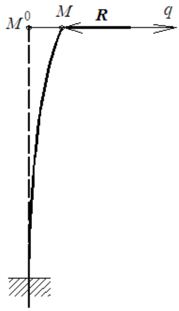

Fig.1. Restorative action.

Conclusions and results.

Given data:

l = 7 m, m_1 = 7 T, m_2 = 4 T, c_1= 700 kN/m, c_2=400 kN/m

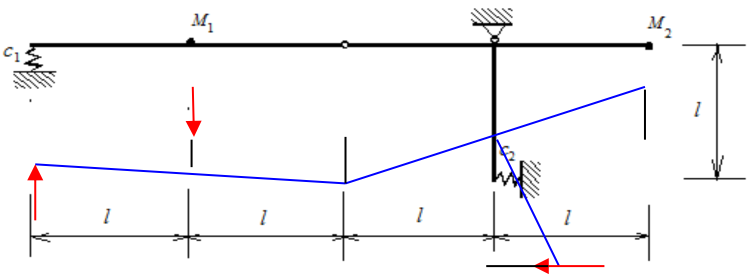

Fig. 2. Unit force action P_1.

Let's make an equation of points:

1) $\sum m_{z(B)}=0$;

$- P_2\, l + R_2\, l = 0$

$R_2 = P_2 = 1$

We find the size of the deformation of the spring:

$$\Delta_2 = \frac{R_2}{C_2} = \frac{1}{400} = \frac{1}{4} \times 10^{-2} \text{ kN/m}$$

$\Delta_B = q_{22} = \frac{1}{4} \times 10^{-2}$ kN/m $q_{12} = -\frac{1}{2} = \Delta_B = -\frac{1}{8} \times 10^{-2}$ kN/m

2) $\sum m_{z(B)} = 0$

$-R_1 \times 2l + P_1 \times l = 0$

$R_1 = \frac{1}{2} P_1 = \frac{1}{2}$

$$\Delta_2 = \frac{R_1}{C_1} = \frac{1}{2 \times 700} = \frac{1}{14} \times 10^{-2} \text{kN/m}$$

$R_2 - 3R_1 + P_1 \times 2l - R_2 l = 0$

$$\Delta_2 = \frac{R_2}{C_2} = \frac{1}{2 \times 400} = \frac{1}{8} \times 10^{-2} \text{kN/m}$$

$\Delta_B = q_{21} = \Delta_2 = \frac{1}{8} \times 10^{-2}$ kN/m

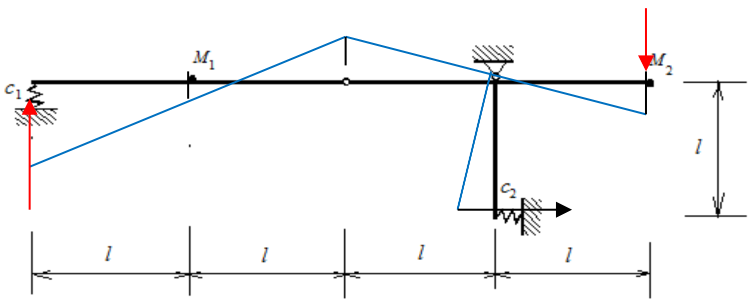

Fig. 3. Unit force action P_2.

We build a pattern of arch-by-design when points oscillate. We find influence ratios:

$q_{12} = -\frac{1}{2} \; \Delta_B = \Delta_2 = \frac{1}{8} \times 10^{-2}$ kN/m

$q_{11} = \frac{1}{2} (\Delta + \Delta_B) = \frac{1}{2} \left(\frac{1}{14} \times 10^{-2} + \frac{1}{8} \times 10^{-2}\right) = \frac{1}{2} \times 10^{-2} \left(\frac{1}{14} + \frac{1}{8}\right) =$

$$= \frac{11}{112} \times 10^{-2} \text{ kN/m}$$

$$q_{22} = \frac{1}{4} \times 10^{-2} \text{ kN/m}$$

$$\Delta_B = q_{21} = \Delta_2 = \frac{1}{8} \times 10^{-2} \text{kN/m}$$

References:

1. V.M. Fomin, I.P. Fomina. Theoretical mechanics. Dynamics. OSACEA. 2019.

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FEATURES OF THE DEVICE OF SOIL-CONCRETE PILES

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Abstract. This article is about soil concrete piles. There are presented the technology of their production, advantages and disadvantages in a paper.

One of the main measures during construction in difficult engineering and geological conditions is the need to strengthen the soil. The stability and reliability of the building under construction depends on the quality of soil strengthening. One of the most effective ways to strengthen the soil is soil concrete piles [1].

The use of soil-concrete piles is most effective when: strengthening of soft soils at the base of buildings, roads, bridges, or tunnels; device of anti-filtration curtains; strengthening of foundations or reconstruction and superstructure of buildings; fencing of foundation pits; increasing the stability of slopes and slopes; filling of karst cavities in fractured rocky soils [2].

For the installation of soil-concrete piles, various technologies and