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THE CARACTERISATION OF THE MACHINE - FOUNDATION SYSTEM IN NONLINEAR VISCOELASTIC SUPORT HYPOTHESIS

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ABSTRACT

The characterization of the influence nonlinear behaviors of mounting elements was make on based of a quantitative criteria of appreciation vibration carry consisted in the evaluation response systems in time and frequency. Present study has based of a physical model with prevalence, which in he considered a machine foundation, as rigid system mount on viscoelastic elements trirectangular. Consequently, the movement of the rigid system has been characterized by dint of six degree of freedom. The physical model considers has a covering prevalence for the many maul real situation, be beyond personalize to according as of analyze characteristic situation.

1. The physical model

For analyze dynamic behavior of the foundation of technological equipment was considered a rigid mount on four identical viscoelastic support trirectangular (fig. 1).

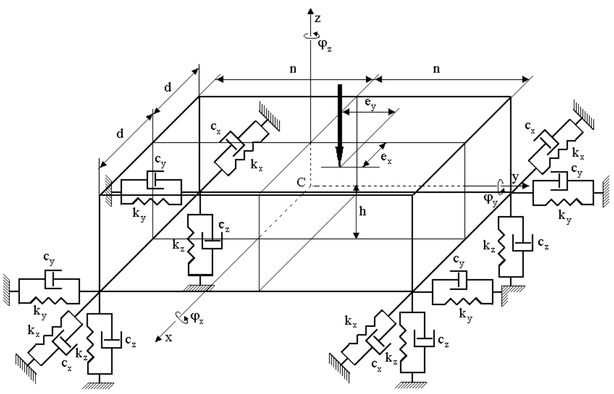

Fig. 1 Physical model

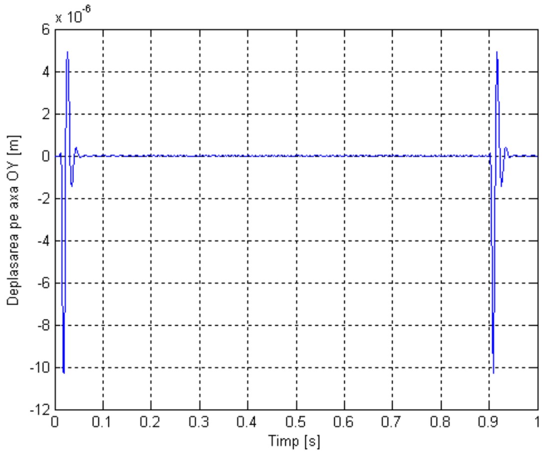

Fig. 2 Semisinusoidal signal

The rigid body was consider is solicits eccentric by signal semi-sinusoidal excitation (semi-sinusoidal shock) presented in fig. 2. Considered as one two coordinate symmetry plane: XOZ, YOZ, situation which in:

$\sum k_{iy} x_i = 0; \sum k_{iz} x_i = 0; \sum k_{iy} x_i y_i = 0;$

$\sum k_{iy} x_i z_i = 0; \sum k_{ix} y_i = 0; \sum k_{iz} y_i = 0;$

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$\sum k_{iz} y_i z_i = 0;$

$\sum k_{ix} y_i z_i = 0; \sum c_{iy} x_i = 0; \sum c_{iz} x_i = 0;$

$\sum c_{iy} x_i y_i = 0; \sum c_{iy} x_i z_i = 0; \sum c_{iz} y_i = 0;$

$\sum c_{ix} y_i = 0; \sum c_{iz} y_i z_i = 0; \sum c_{ix} y_i z_i = 0;$

In this situation the system of differential equations which describes rigid body movement becomes:

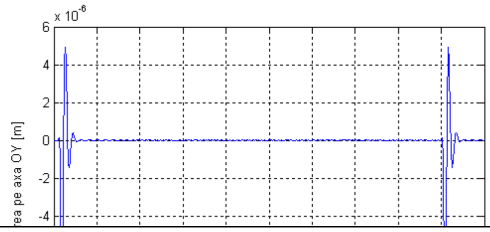
$$\begin{cases} m\ddot{X} + 4c_x\dot{X} - 4hc_x\dot{\varphi}_y + 4k_xX - 4hk_x\varphi_y = 0 \\ m\ddot{Y} + 4c_y\dot{Y} + 4c_yh\dot{\varphi}_x + 4k_yY + 4k_yh\varphi_x = 0 \\ m\ddot{Z} + 4c_z\dot{Z} + 4k_z\dot{Z} = -F_z \\ J_x\ddot{\varphi}_x + 4hc_y\dot{Y} + 4\left(c_yh^2 + c_zn^2\right)\dot{\varphi}_x + 4hk_yY + \\ \qquad + 4\left(k_yh^2 + k_zn^2\right)\varphi_x = -e_yF_z \\ J_y\ddot{\varphi}_y - 4hc_x\dot{X} + 4\left(c_zd^2 + c_xh^2\right)\dot{\varphi}_y - 4hk_xX + \\ \qquad + 4\left(k_zd^2 + k_xh^2\right)\varphi_y = e_xF_z \\ J_z\ddot{\varphi}_z + 4\left(c_xn^2 + 2c_yd^2\right)\dot{\varphi}_z + 4\left(k_xn^2 + 2k_yd^2\right)\varphi_z = 0 \end{cases}$$

2. The coupling mode $\left(Y, Z, \varphi_x\right)$

The system is decupling in two separated subsystem with independent moves. The system equation, in these case are:

$$\begin{cases} m\ddot{Y} + 4c_y\dot{Y} + 4c_yh\dot{\varphi}_x + 4k_yY + 4k_yh\varphi_x = 0 \\ m\ddot{Z} + 4c_z\dot{Z} + 2c_z\left(n_2 - n_1\right)\dot{\varphi}_x + 4k_zZ + \\ +2k_z\left(n_2 - n_1\right)\varphi_x = -F_z \\ J_x\ddot{\varphi}_x + 4hc_y\dot{Y} + 2c_z\left(n_2 - n_1\right)\dot{Z} + \\ +3\left[2c_yh^2 + c_z\left(n_2^2 + n_1^2\right)\right]\dot{\varphi}_x + \\ +4hk_yY + 2k_z\left(n_2 - n_1\right)Z + \\ 2\left[2k_yh^2 + k_z\left(n_2^2 + n_1^2\right)\right]\varphi_x = -e_yF_z \end{cases}$$

In hypothesis of digital values: $P=10\cdot10^5$N; $k_y=10\cdot10^8$ N/m; $c_y=30\cdot10^5$ Ns/m; $m=45\cdot10^3$ kg; $k_z=20\cdot10^8$ N/m; $c_z=30\cdot10^5$ Ns/m; $J=65\cdot10^5$ kgm^2; $e=0.2$m; $n_1=1$m; $n_2=2$m; $h=1$m, the movements on OY and OZ axis, as well the rotation round OX axis are represented in fig. 3, 4 and 5.



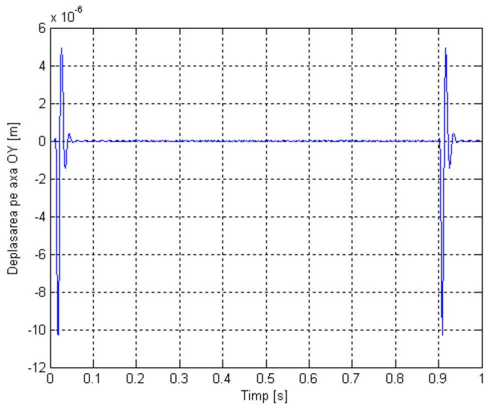


Fig. 7

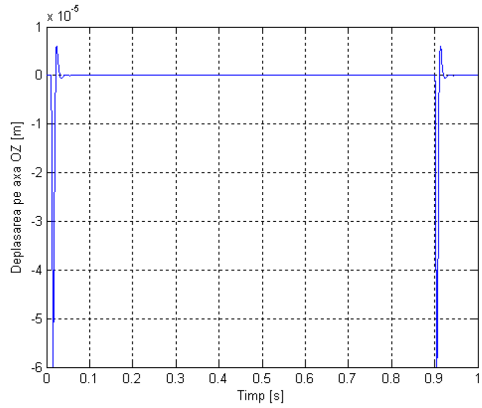


Fig. 4

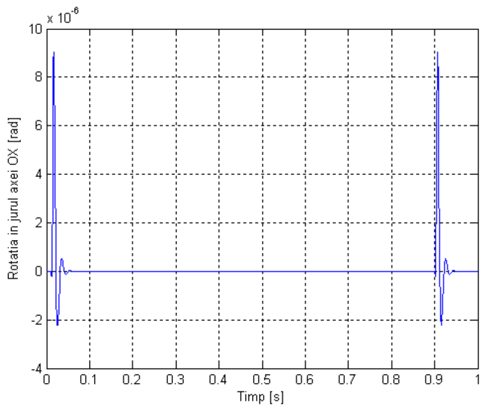


Fig. 5

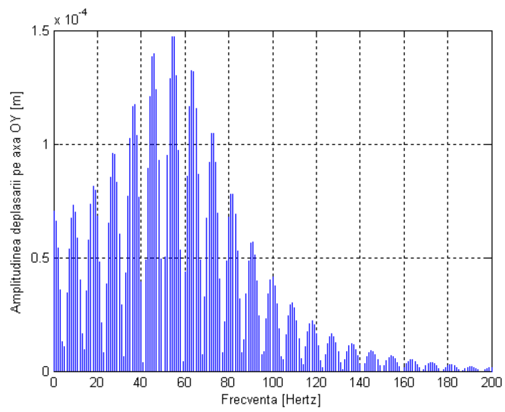


Fig. 6

For the system vibration on OY direction, the frequency responses is presented in fig. 6, and the frequency system responses on OZ axis is presented is fig. 7.

For the system vibration round axis OX, the responses in frequency is presented in fig. 8.

5. Conclusion

From the accomplish study, observe as in the cases of nonlinear elastic and damping forces, the frequency characteristic is characterized by appearance of new spectral values, by the of with first case which considered the force have linear expressions.

Present these poliharmonic components is proven the value of dissipation energies on one period: in the case of nonlinear damping forces dissipation energies has greatest value.

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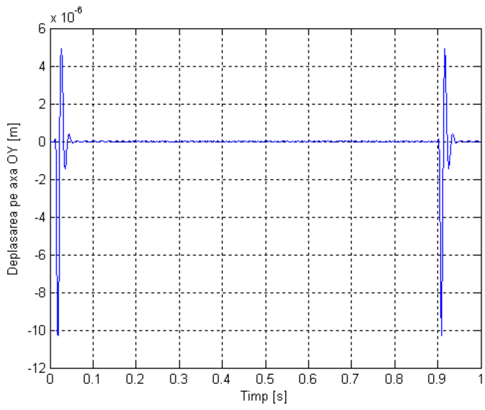

Fig. 8