THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICAL ENGINEERING, ISSN 1224-5615
2002

THE INFLUENCE OF THE VISCO-ELASTIC DAMPERS ON TECHNOLOGICAL EQUIPMENT

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ABSTRACT

In this paper it's presented the case of technological equipment which are dispose on the visco-elastic elements, and which develop shocks and vibrations in the time of the work. Using the simplified hypothesis we developed a dynamical model who offer the possibility to formulated of evaluated conclusions for the influence of the vibrations on the technological equipment.

1. Introduction

In this paper it' s presented the case of the press with eccentric, who is an technological equipment which has to develop a mechanical work of great value in a short time, consequently with an intensive effort. In the time of the work, are developed shocks and vibrations, which are propagate to technological equipment and to neighbor buildings. From the technological process results shocks which to transmit on long distance, especially water are favorable of this propagation.

The vibrations which to transmit on the neighbor work shops, on office, or an habitat buildings and on the technological equipment, can be harmful in consequence is necessary to take a special measures at the foundation execution.

In this case is needful the damping this vibrations, whit a visco-elastic elements between equipment and foundation. In this manner, the vibrations what are propagated on neighboring buildings are diminished.

2. The physical-mathematical model

For study of this case, is necessary to elaborate a physical-mathematical model, which describes at the accurate the real case.

We will considerate an visco-elastic elements which supported the press with eccentric and the foundation with big dimension is dispose on soil, which is considered visco-elastic. In these case, for to realize both o pressure on floor in the acceptable limits and to obtained namely self frequency, under machine is dispose a foundation block.

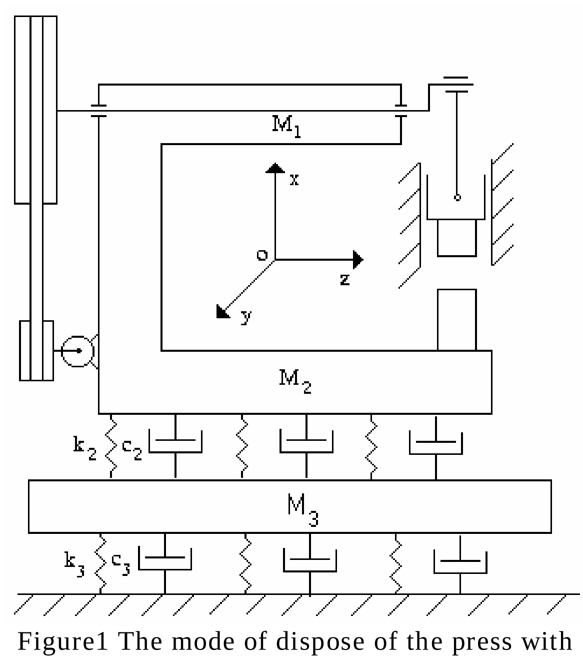

Figure1 The mode of dispose of the press with eccentric

In this purpose must elaborated a dynamical model much complete which that develop the mathematical model.

A model is presented in figure 1, where has usage the next notations:

M_1 – represent the upper of the body of the press with eccentric;

M_2 – represent the bottom of the body of the press with eccentric;

M_3 – represent the foundation mass.

k_2 – represent the elastic constant of the bond element between the mass M_2 and foundation;
k_3 – represent the elastic constant of the elastic soil;
c_2 – represent the amortization coefficient of the bond element between the mass M_2 and the foundation;
c_3 - represent the amortization coefficient of the soil.

For the elaboration of the physical - model we' ll consider the next hypothesis:

- the masses we' ll considerate concentrated in the center of mass;
- we neglecting the rotational movement of the mass M_1 toward the mass M_2;
- for the system we' ll considerate translation only on x direction;
- the friction from bedding are considered zero;
- the excitement force we' ll considerate $F(t)=F\sin\omega t$;
- the press with eccentric is compound from two masses like in figure 2.

Take into consideration these simplified hypothesis, the dynamical model of the press

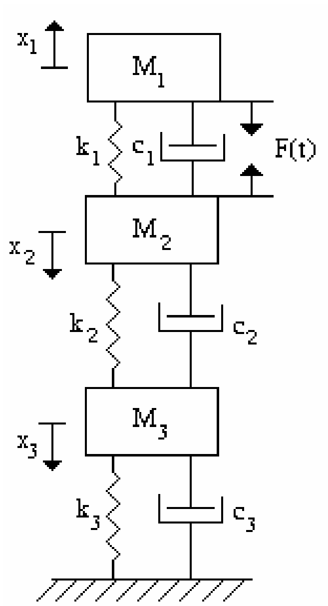

Figure. 2 The dynamical model of the press with eccentric

with eccentric will be come like in the figure 2: where:
k_1 – represent the elastic constant of the bond element between the mass M_1 and the M_2;
c_1 – represent the amortization coefficient of the bond element between the mass M_1 and the mass M_2.

This mechanical system, have three degree of freedom, so the movements equations are:

$$M_1 \cdot \ddot{x}_1 + c_1 \cdot (\dot{x}_1 + \dot{x}_2) + k_1 \cdot (x_1 + x_2) = F(t);$$
$$M_2 \cdot \ddot{x}_2 + c_1 \cdot (\dot{x}_1 + \dot{x}_2) + c_2 \cdot (\dot{x}_2 - \dot{x}_3) + k_1 \cdot (x_1 + x_2) + k_2 \cdot (x_2 - x_3) = F(t); \quad (1)$$
$$M_3 \cdot \ddot{x}_3 + c_2 \cdot (\dot{x}_3 - \dot{x}_2) + c_3 \cdot \dot{x}_3 + k_2 \cdot (x_3 - x_2) + k_3 \cdot x_3 = 0;$$

where:
x_1 - represent the elongation of concentred mass M_1;
$\dot{x}_1$ - is the translation speed of the mass M_1;
$\ddot{x}_1$ - is acceleration of the mass M_1;
x_2 - represent the elongation of concentred mass M_2;
$\dot{x}_2$ - is the translation speed of the mass M_2;
$\ddot{x}_2$ - is acceleration of the mass M_2;
$\dot{x}_3$ - is the translation speed of the mass M_3;
$\ddot{x}_3$ - is acceleration of the mass M_3;
x_3 - represent the elongation of the fundament.

The numerical solving of the equations system is made trough known algorithms, or by the Runge – Kutta method, or by finite differences, the stability of the solution and the precision of the result depend only on the value of the time - increment which must be smaller than 0.001 seconds.

For the numerical value of the equations system parameters, we obtain the variation of the velocities and displacements of the masses:
c_1=10000 Ns/mm;
c_2=800 Ns/mm;
c_3=10000 Ns/mm;
k_1=100000 N/mm;
k_2=3000 N/mm;
k_3=60000 N/mm;

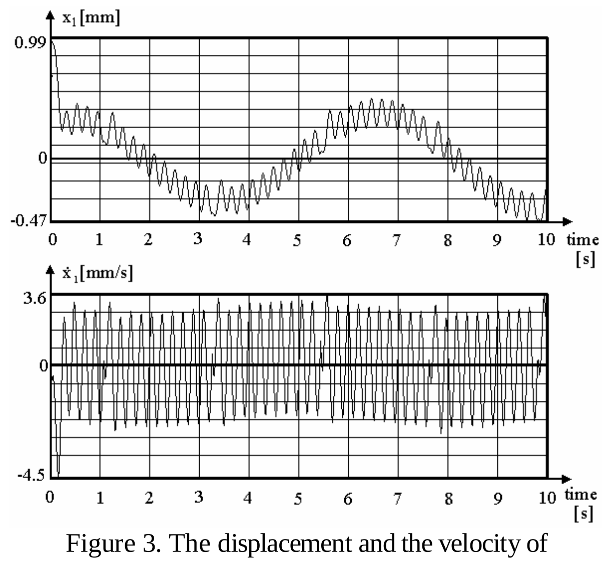

Figure 3. The displacement and the velocity of the mass M_1

M_1= 1000 kg;
M_2=1000 kg;

M_3=2000 kg
F=100000 N;
ω=50 rad/s.

By programming the numerical model on the computer, the results are graphically presented in the next figures, the as evolution of sizes in time. So in the next figures are presented the variations for displacement and velocities of the M_1, M_2 and M_3 masses.

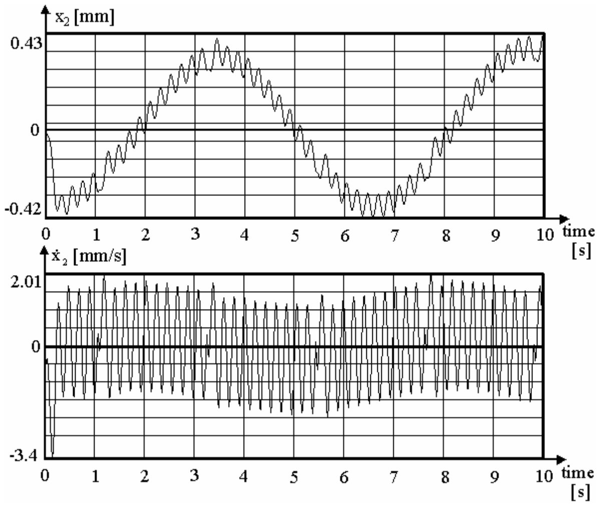

Figure 4 The displacement and the velocity of the mass M_2

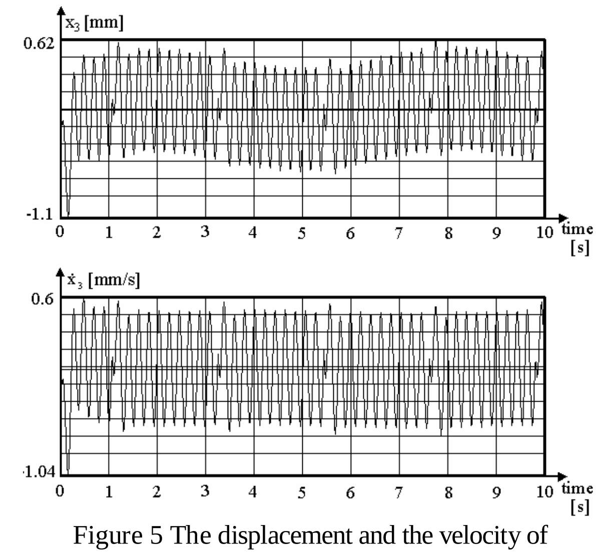

Figure 5 The displacement and the velocity of the mass M_3

The parameters which describes the evolution of the technological equipment in the time of the work, are the differences between displacements of masses M_1 and M_2, and the differences between velocities of the same masses.

In this mode we obtain the relative movement between the mass M_1 and the mass M_2, which getting help in the evaluation of the vibrations influence on the technological equipment (fig. 6).

In the next we’ll consider the case with another numeric values for the elastic constant k_2 and amortization coefficient c_2*:*
c_2=2000 Ns/mm;
k_2=6000 N/mm.

For this values of the elastic constant and the amortization coefficient we obtain the differences between the displacements and the velocities of the M_1 and M_2 masses, like in

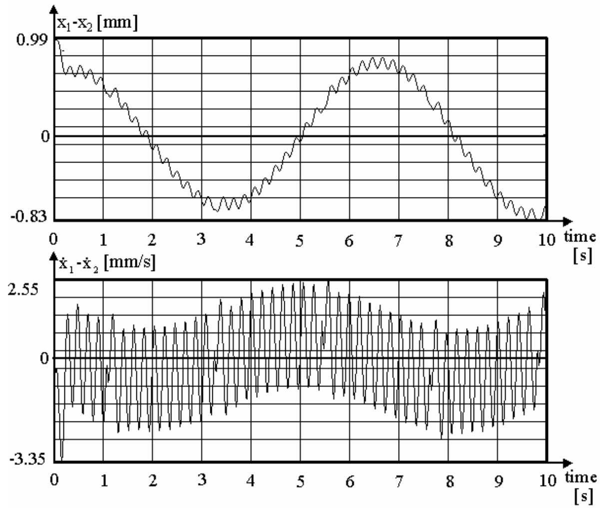

Figure 6 The differences between the displacements and the velocities of the M_1 and M_2 masses

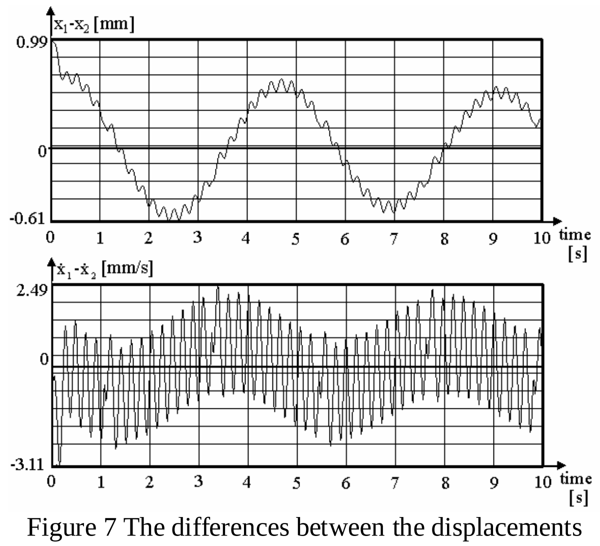

Figure 7 The differences between the displacements and the velocities of the M_1 and M_2 masses

figure 7:

For these numeric values we obtain the difference between displacements of masses M_1 and M_2, and difference between velocities of the same masses.

If we compare the relative displacement and velocities of the M_1 and M_2 masses, between the fig 6 and the fig 7, we observe a small difference which conduct on the next conclusion: the values of the elastic constant and amortization coefficient of the damping element between equipment and foundation are small influence the behavior in service of the technological equipment.

The relative moving of the masses M_1 and M_2 conduct on beats phenomenon, which result from composition of the more harmonic oscillation, in our case oscillations of the masses M_1 and M_2.

Although this physical simulation of the press with eccentric is simple, because we have made more simplifyed hypothesis, the presented model can be easily completed with more detailed relations, all finally resuming, in the case of numerical modeling, to a shorter or a longer period of calculating.

For different numerical values of the elastic constant k_2 and the amortization coefficient c_2, we obtain various value for the modulation frequency of the beats.

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