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PERFORMANCE OF MULTIPLE TUNED MASS DAMPER

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Introduction

For many years there has been considerable interest in the design of devices that, when added to an engineering system, will reduce significantly the vibration response. These devices have been implemented in a wide variety of structures, including tall buildings, bridges or machine foundations. The main disadvantage of a single TMD is its sensitivity of the effectiveness to the error in the natural frequency of the structure. The use of multiple tuned mass damper (MTMD) with frequencies tuned in the neighbourhood of the natural frequency of a structure improves the performance of the TMD. Optimum parameters of the MTMD used to reduce vibrations of construction and various tuning rules under different input function were examined by researchers (Dukart & Olejnik, 2002; Jangid, 1999; Joshi & Jangid, 1997).

The objective of this study is to find the optimal MTMD for isolated stamp subjected to the harmonic ground excitation.

Basic assumptions

Fig. 1 shows a dynamic system with the MTMD subjected to a harmonic ground acceleration.

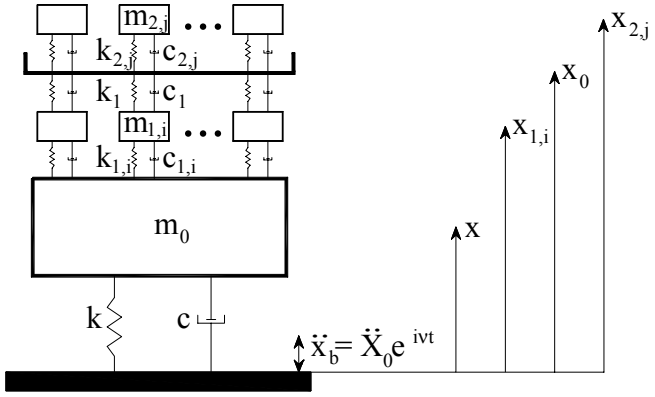

Fig.1: Model of analyzed system

Conditions of fastening of platform ensure no rotional vibrations. The effectiveness of the

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two-level MTMD will be analysed on the assumption that all masses on each level are the same. The analysed main system and each TMD are modelled as a single degree of freedom system. So that, the total degrees of freedom of the structural system is $m+n+2$.

The differential equation of motion of the system shown in Figure 1 can be written in the form:

$$\mathrm{M}\ddot{\mathrm{X}} + \mathrm{C}\dot{\mathrm{X}} + \mathrm{KX} = -\mathrm{Mr}\ddot{\mathrm{x}}_{\mathrm{b}}(\mathrm{t}) \tag{1}$$

where M, C, K represent the mass matrix, the damping matrix and the stiffness matrix, respectively.

Results and discussion

It is assumed that the damping ratio of the main mass is $\xi = 0{,}1$ and the values of mass ratio is $\mu = 0{,}05$.

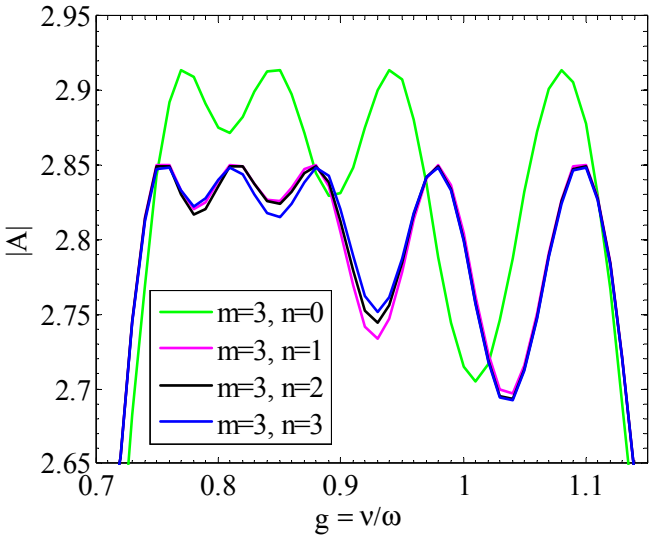

Fig. 2: Variation of main mass amplification factor $|A|$ with excitation frequency ratio g for system with two-level MTMD

Conclusions

The results of calculations are promising because proposed MTMD can suppress vibrations significantly. It was found that the efficiency of the analysed MTMD with two levels is higher than the MTMD with one level. The numerical study shows that an increase in the number of levels leads to better performance of the optimal MTMD.

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