The 3rd International Conference on "Computational Mechanics
and Virtual Engineering"
COMEC 2009
29 – 30 OCTOBER 2009, Brasov, Romania

PERFORMANCE CONCEPT IN CASE OF INSULATION SYSTEMS INTENDED FOR VIBRATORY AND SEISMIC MOTIONS

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Abstract: *This paper presents the final results of the research carried out by ICECON Bucharest. Thus, taking into account the interior comfort, the categories of installation equipment providing the building functionality as well as water and thermal energy supplying systems are analyzed. In this case, the above mentioned categories of installation equipment are framed into construction embedded equipment and should be in accordance with noise and vibration requirements expressed by limit values stated by the European Directives 89/106/EC (construction products) and 42/2006/EC (machinery). Basing on the essential requirements stated in the Directives regarding health and safety, interior comfort related to noise and vibration, as well as building safety and stability, this paper deals with the vibration insulation concept and the permissible level expressed by the insulation degree.*
Keywords: *performance level, vibration insulation*

1. INTRODUCTION

The passive insulation for vibrations transmitted to buildings with various use where human occupants perform occupational activities or rest themselves, represent a regulated study and analysis field for the interior comfort. Thus, the approach of passive vibration insulation should take into account the following requirements to be fulfilled:

- stating of the limit level for the vibrations transmitted to human occupants, as a function of the building category, the activities to be performed as well as relax and rest conditions;
- provision of stable operation of the dynamic equipment by means of geometrical and mass configuration as well as elastic supporting, in order to decouple the eigen vibration modes. The dynamic equipment is modelled as a rigid having six freedom degrees and elastic links to the building structure and a certain geometry and mass distribution. In order to avoid a chaotic motion due to the six coupled vibration modes, both the elsting supporting and the mass distribution should be analyzed, aiming to partial or total decoupling of the eigen modes. This means that generating a motion (dispalcement) in a certain direction (kinematically or dynamically) does not result in a motion in the other characteristic directions.
- attaining of a vibration insulation degree so that the vibrations transmitted to huma body should be reduced in the permissible limits as well as the forces transmitted to the resistance structure of the building that should be framed in the safety limits concerning resistance and deflection.

2. PERFORMANCE CONCEPT

For the vibration passive insulation, the performance concept represents the fundamental procedure to state the necessary level of the technical characteristics intended to satisfy the requirements provided by the reference documents, related to use and users.
The passive insulation system consists of equipment rigid structure, elastic elements and the geometrical configuration for the elastic links location. Thus, the equipment is modelled as a rigid with six dynamic freedom degrees and elastic links.

2.1. Structure of the passive insulation system

In order to decouple the eigen vibration modes, two conditions should be taken into consideration, namely the equipment mass system should have a simmetrical distribution related to the median longitudinal planes and a simmetrical distribution of the elastic supports. The mass and elastic simmetry condition involves that one or more

longitudinal simmetry planes contains the equipment centre of gravity. In this case, the motions are grouped by coupled systems and the linear displacement applied in a direction contained in the simmetry plane would not generate motions contained in this plane.

Figures 1, 2 and 3 illustrate three cases for an equipment modelled as a rigid with one simmetry plane (figure 1) with two groups of coupled motions (y, z, φ_x) and (x, φ_y, φ_z); with two simmetry planes (figure 2) with four groups of motions, two of them being coupled, (x, φ_y) and (y, φ_x) and two decoupled z; φ_z and with three simmetry planes and complanar elastic supports having the centre of gravity with all the modes decoupled, each dynamic coordinate being independent, expressed by decoupled motions x, y, z, φ_x, φ_y şi φ_z (figure 3).

The convergence condition for the elastic axis with the centre of gravity leds to the partial decoupling of the vibration modes. In this case, the elastic elements should be mounted leaned to the mass system axis having two longitudinal symmetry planes (figure 4).

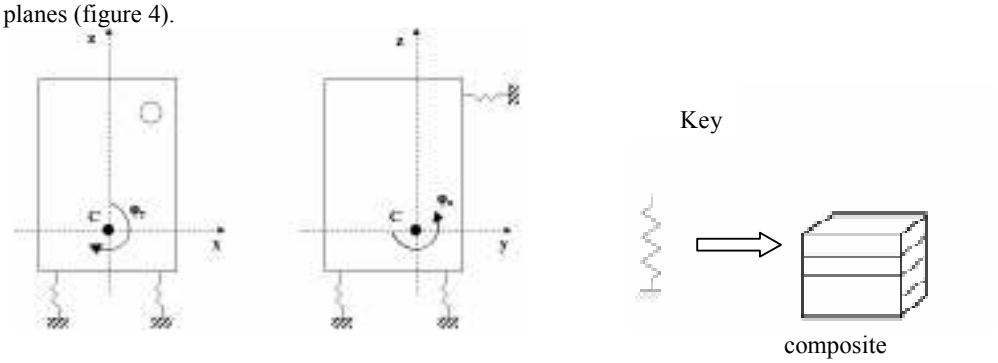

Figure 1: Coupled motions (y, z, φ_x), (x, φ_y, φ_z)

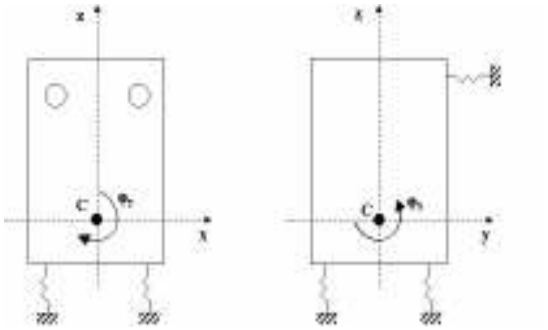

Figure 2: Coupled motions (x, φ_y) and (y, φ_x); decoupled motions z and φ_z

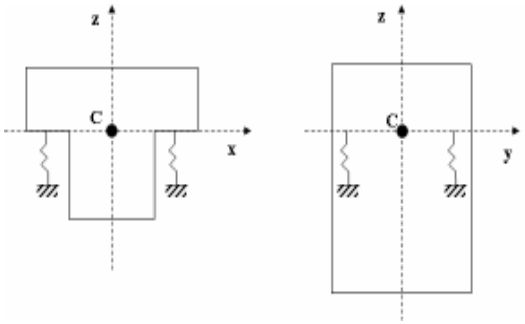

Figure 3: Decoupled motions (independent) x, y, z, φ_x, φ_y and φ_z

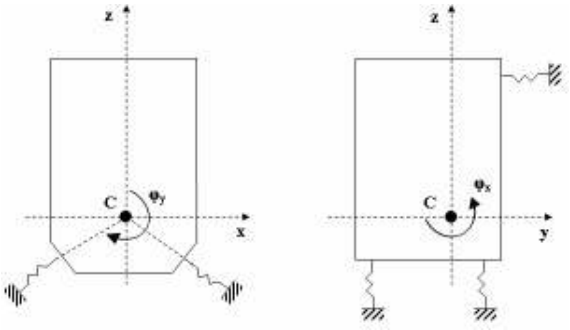

Figure 4: Coupled motions (x, φ_y) and (y, φ_{xs}); decoupled motions z and φ_z

3. PERFORMANCE LEVEL FOR THE VIBRATION PASSIVE INSULATION SYSTEMS

The performance level is imposed by the specific requirements intended to provide the interior comfort for the building occupants, as well as to avoid the structural degradations. Thus, the synthesis parameter for the passive system performance is the vibration insulation degree *I*, complement to the vibration transmissibility *T*, by relation $I = 1 - T$. The dimensionless quantities *T* and *I* can be expressed in percentage.
Table 1 presents the performance levels for the vibration insulation in case of vibrations transmitted by the embedded equipments intended to provide the building functionality. Thus, the performance level is expressed by the rated insulation degree and the recommended insulation degree.

Table 1: Performance levels

NO	Equipment		Insulation degree I, %	
			Rated values[1]	Recommended values[2]
1	Air-conditioning unit (single casting)		90	70
2	Air treatment unit		90	70
3	Centrifugal compressor		95	80
4	Piston compressor	< 10 CP	85	70
		10 - 15 CP	90	75
		50 – 150 CP	95	80
5	Heating and ventilating unit		90	70
6	Cooling tower		90	70
7	Evaporation air condenser		90	70
8	Pipe network		90	70
9	Pump	< 3 CP	85	70
		> 3 CP	95	80

[1)] For churches, restaurants, offices, dwellings, schools, hospitals, RTV studios.
[2)] For factories, laundries, garages, technical underground, intermediary levels.

4. CONCLUSION

Verification of vibration passive insulation efficiency at a given performance level stated on the basis of the insulation degree is carried out by measuring the rms velocity of the transmitted vibrations. Thus, in this case, the assessment of the manner how the transmitted vibrations affect the building functional units bases on the following criteria:
- psycho-sensitive response of the human body;
- structural response by likely immediate or time-degradations;
- the equipment vibration severity in correlation with the sensitivity and accuracy of devices intended for measuring, monitoring and providing the functional parameters in buildings designated to host laboratories, hospitals etc.

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