Congress on Numerical Methods in Engineering
Lisboa, June 29 to July 02, 2015
© APMTAC, Portugal, 2015

RESUMO N° 160

A TWO-STEP NUMERICAL PROCEDURE FOR THE ANALYSIS OF RE-RADIATED NOISE FROM UNDERGROUND TRANSPORTATION MEANS

Luis Godinho, lgodinho@dec.uc.pt
Universidade de Coimbra, Portugal

Paulo Amado Mendes, pamendes@dec.uc.pt
Universidade de Coimbra, Portugal

Pedro Alves Costa, pacosta@fe.up.pt
Faculdade de Engenharia da Universidade do Porto, Portugal

Keywords: Coupled Methods, Acoustics, Wave Propagation

Wave propagation in acoustic and elastic media with heterogeneities has been extensively researched in the last years. Engineering problems involving soil vibration generated by transportation means have received particular attention from researchers, attempting to accurately reproduce field conditions and to predict the vibrational effects of train or road vehicles. The particular case of noise and vibration from underground trains has been addressed using a variety of methods, either hybrid or purely numerical. One topic that is still under research is related to the noise re-radiated into dwellings originated by the soil vibrations induced by passing trains in tunnels.

The present paper aims to present a possible strategy for addressing this problem, making use of a two-step numerical procedure, defined in the frequency domain. First, the train-tunnel-soil-building interaction problem is tackled by means of a coupled model using a multi-body approach, the MFS (Method of Fundamental Solutions) and the FEM (Finite Element Method). The first method is used to simulate the dynamic behaviour of the train. The MFS is then applied for the simulation of the hosting infinite elastic environment and the FEM for both the tunnel and the building structure. Then, in a second step, the vibrational response of the building structure is used as the input for an acoustic BEM (Boundary Element Method) model which allows estimating the sound levels within the dwellings' compartments. The uncoupled character of the second step is justified by the weak interaction that occurs between the air inside the dwellings and the structure, due to the huge contrast of the media densities and wave propagation velocities. The method is formulated in the frequency domain, allowing an easy implementation of distributed computations, and it is then verified against analytical solutions. Results are presented illustrating the possible interest of this formulation.