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TRAIN-INDUCED SOIL VIBRATION USING A NEW PERIODIC BOUNDARY ELEMENT FORMULATION

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Summary

The numerical analysis of extended structures involving unbounded media as the soil has always had the requirements of a large amount of computational time, since the models should usually be extended far away from the main source of the perturbation and, in many cases, an appropriate absorbing boundary should be placed at the end of the discretization to ensure the waves to propagate towards the infinite. These problems can be better handled using the Boundary Element Method (BEM) method, which naturally avoids the interior domain discretizacion, accounting appropriately for the unbounded characteristics of the media. However, many of these BEM models should still be extended to long distances over the surface of the media, becoming sometimes very time consuming. When dealing with periodic structures, the problem can be significantly reduced by taken into account the periodicity of the displacement and tractions fields. This property allows considering a very much reduced discretization of the media.

Depending of the periodicity characteristics, different approaches have been developed in past years. When the media has constant properties along one spatial direction and the loads have periodicity along the same directions (or can be expressed in terms of periodic loads) a two dimensional model can be applied to solve the problem if it is expressed in the frequency-wave number domain. These models are limited to media and structures having constant properties and constant geometry along the main axis.

When the properties or geometry are not constant but still have periodicity, a different approach may be used considering a periodic decomposition of the domain. A new procedure is proposed in this paper, using the symmetry and asymmetry properties of the model and working in the frequency domain. The goal of the proposed method is to provide an easy implementation in standard codes since it reproduces the usual workflow in them, not requiring any especial formulation. The periodic domain is represented in the model by a discrete module of the mesh. In the original model, this module is repeated towards the infinite, forward and backward. When the separation planes between the reference module and the two consecutive modules are defined as symmetry planes, the discretization of the modules apart from the reference module can be avoided. A significant reduction of mesh size and time calculation is obtained with the proposed method. The procedure is applied to obtain the train-induced vibration in the soil for different track and soil configurations.