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ScienceDirect

Procedia Engineering 199 (2017) 302–309

Procedia Engineering

www.elsevier.com/locate/procedia

X International Conference on Structural Dynamics, EURODYN 2017

Effect of periodic pile row in subway vibration Isolation

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Abstract

At present measures for reducing vibration by subway are mainly from vibration source, path and building, where vibration isolation on path is an important one. This article studies the effect of periodic pile row in subway vibration Isolation for a planned building close to a subway in Beijing based on phonon crystal theory. First test the vibration of surface field and get the vibration characteristic frequency. Second calculate the attenuation zone of periodic pile row which contains the vibration characteristic frequency, and get the parameter combination of the pile. Third A track-tunnel-soil-building 3D finite element model was established by software ANSYS. Input the force of vibration source calculated by the model of vehicle and guideway coupling. Then use the finite model to calculate the effect of the periodic pile row. The result shows that the working frequency of the periodic pile row is higher than 12Hz. The Damping capacity of the largest Z vibration level is 4.13dB on the first floor, and the Damping capacity becomes greater with the increase of the floor. Periodic pile row based on phonon crystal has a wide vibration isolation frequency and a good vibration isolation performance.

Peer-review under responsibility of the organizing committee of EURODYN 2017.

Keywords: subway; periodic pile row; simulation; field test

1. Introduce

With the rapid development of urbanization in China, urban rail transit is the main method to alleviate the urban traffic congestion because of the advantages of large volume, fast, punctual, environmental protection. Because most of the urban rail is located in the center of the city, the vibration problem caused by the operation of the urban traffic congestion gradually attracted people's attention. Vibration can affect people's normal life, reduce the service life of

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1877-7058
Peer-review under responsibility of the organizing committee of EURODYN 2017.
10.1016/j.proeng.2017.09.043

buildings, and affect the use of precision instruments. Source of vibration damping, vibration isolation in the transmission path, passive vibration isolation in building are the three main ways of solve the problems of the urban rail transit vibration. Vibration isolation in the transmission path mainly includes the empty ditch, filling ditch, single row pile and multi row piles.

Barkan [1] (1962) first reported the Isolation ditch and sheet pile wall used in engineering to reduce vibration, and the test effect of vibration reduction of the two methods. Woods [2] (1968) researched the effect of the empty ditch by experiment, and put forward that should use the Amplitude attenuation coefficient as the criteria of effect of vibration isolation, the index was applied to evaluate various barrier isolation effect; Woods [3] (1974) tested the effect of reducing vibration of empty ditch Test conclusion: the depth of empty ditch reaches 1.33 times of the Rayleigh wavelength, can effectively block vibration wave.

XiaoyanLei [4,5] (2006,2010)established the mechanical model of railway vibration isolation ditch, analyzed the damping effect of the isolation ditch depth, width and position by finite element software ANSYS. XiaoyanLei [6] (2008) showed the research results of the isolation ditch by the finite element method, concrete isolation ditch has a better effect In about 5 m away from the barrier, the overall effect of rubber isolation ditch isolation is better, and the composite isolation ditch can play the advantages of two kinds of isolation ditch that has a good vibration isolation effect.

A three-dimensional finite element simulation model was established by Wenbin Wang[7], and the vibration isolation effect of vibration isolation barrier with different filling materials was studied.

In recent years, scholars have made a deep study on the suppression of some frequency waves by the periodic structure, and put forward the concept of phonon crystal. In this paper, we calculate the band gap of vibration isolation piles, and design the periodic pile row to reduce the vibration caused by subway.

2. Field Test

In order to understand the vibration characteristics of the rail and the ground surface caused by the subway operation, test the vibration acceleration of the rail and the ground surface of Beijing subway line. The test is based on the ordinary track bed, and the field test situation as shown in figure 1.The vibration acceleration time history and frequency spectrum of rail are shown in Figure 2. The vibration acceleration time history and frequency spectrum of ground are shown in Figure3.

a b

Fig.1.(a) rail acceleration measuring-point arrangement;(b)ground surface acceleration measuring-point arrangement