TOPOLOGY OPTIMIZATION OF WAVE BARRIERS FOR MITIGATION OF ROTARY MACHINE-INDUCED GROUND VIBRATIONS

Abstract

Rotary machine-induced waves generate ground vibrations, which causes discomfort to the people who live in nearby structures and malfunction to the sensitive equipment. One of the most common solutions for mitigating these vibrations with medium frequency content, which has been used by different researchers, is screening the waves and vibrations using the wave barriers. There are several parameters affecting the mitigation capacity of these wave barriers, such as their position and shape, material distribution, and the type and nature of loading. In this study, a new and comprehensive method has been introduced in order to find the optimal configuration of the wave barriers and investigate the effect of different parameters on mitigation capacity of these wave barriers. The system of wave barriers and soil profile has been modeled using commercial finite element (FE) ABAQUS software. In order to calculate the optimal configuration of the wave barrier, genetic algorithm (GA) heuristic optimization method is used. The obtained results indicate that the wave barriers tend to locate far from the source of vibration and near the sensitive structures (i.e. passive isolation). This can reduce the vibrations as much as 23 percent. In addition, the frequency content of loading has a significant effect on the optimal pattern of the wave barriers. Another important finding is that increasing the volume of material used in wave barriers does not necessarily increase the mitigation capacity of the wave barriers. The results show that softer materials such as special soil-bentonite mixtures can better mitigate the vibrations comparing to stiffer materials such as weak concrete. This difference can be as much as 16 percent. Also, the soil damping does not have a significant effect on the performance of the wave barriers.

Keywords: Machine foundation; Vibration Mitigation; Wave Propagation; Wave Barriers; Topology Optimization; Finite Elements; Genetic Algorithm