ABSTRACT

In metropolitan cities underground railway lines of Mass Rapid Transit Systems (MRTS) are the lifeline to the daily commuters. When trains move along underground tunnels vibrations are generated at wheel-track interface. These generated vibrations then travel through the tunnel lining and surrounding soil to reach the ground surface and nearby structures. The major concern of this ground-borne vibration is annoyance of residents living nearby underground metro alignment. Moreover, although vibrations induced by railway traffic do not structurally damage modern buildings, there are incidences of structural damage or façade damage of heritage buildings and non-engineered masonry buildings. Therefore, detailed study of vibration characteristics of underground tunnels naturally becomes an important research subject. The objective is to develop an analysis method based on earlier research works on similar problems and validate the obtained results with the field measured results from operational metro line. Thereafter performing parametric study by varying parameters which influence the vibration characteristics of the problem. Using analysis results of parametric study perform regression analysis using ANN model to find relationship of individual parameter with the vibration response at the ground surface. Finally preparing design charts which may be used for accurately predicting peak vibration response at ground surface based on salient input parameters for any tunnelling project.

Numerical analysis model in 2D FE using coupled analysis of two sub-models is proposed. Another study in 3D FE is performed and the results are compared with in-situ measurements and 2D FE results. It is observed that 2D FE results are reliable and reasonably accurate. Therefore, parametric studies are performed in 2D FE analysis. The ground borne vibrations caused by underground train is influenced by several factors such as tunnel's shape, depth and distance of tunnel, the stiffness of the surrounding soil and the speed of the train. In some conditions of shallow depth tunnel and soft ground condition, the vibration levels at the surface can surpass the threshold that may cause damage to sensitive buildings. The vibration amplitude also exceeds the threshold limit of human perception for shallow depth tunnels. The produced design charts and ANN model can be useful for design engineers working in industry for assessment of ground vibration.