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**Full surface wave attenuation using 2-D elastic metamaterial thin plates to attenuate railway-induced vibration in low frequencies**

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The scientific community is constantly looking for cutting edge strategies to attenuate surface ground-borne waves from railway to reduce structural damage and to increase people health and safety. Recently, the elastic metamaterials (EMs) have been used as potential candidates to attenuate railway-induced waves in low frequencies. In this study, 2-D EM thin plates with periodic inclusions are used to provide full wave attenuation (i.e., flexural and in plane waves) in low frequencies (i.e., until ~160 Hz). The improved plane wave expansion (IPWE) and the extended plane wave expansion (EPWE) approaches are derived to obtain the dispersion diagram of the 2-D EM thin plates. First, different materials for the inclusions are regarded, that is to say concrete, steel, and lead. Next, a silicone coating is included and its effect is investigated. Finally, piling tubes of concrete are also analyzed. It is observed that the 2-D EM thin plates are potential candidates for full surface wave attenuation in low frequencies in the soil. The piling tubes of concrete are an interesting option, since less material may be used to tailor the inclusions for higher attenuation than the filled concrete inclusions. They are the best option in terms of band gap width and unit cell wave attenuation, regarding flexural waves. However, for in plane unit cell wave attenuation, the filled inclusions of concrete show better performance.