PROJECT TITLE: Assessing the sustainability of a novel engineered material for vibration mitigation

Project Supervisor: Dr Julian M Londono, University of Exeter , Engineering

Co-Supervisor: Prof Maria Rosaria Marsico, University of Exeter, Engineering

Project Enquiries: j.londono-monsalve@exeter.ac.uk

Project keywords: Graphene-reinforced polymers, experimental testing, recycled rubber.

Proposed start date: 4th June 2024.

Project description:

Urban densification and the continuous expansion of railway networks have significantly increased the exposure of buildings to vibrations. These vibrations, propagated from passing trains or underground tubes, can lead to disrupted sleep and whole-body vibration anxiety of occupants. Reducing the increasing exposure to vibrations is essential to ensure the comfort of large cities and the wellbeing of their residents.

This project will look into further developing a novel engineered material for vibration mitigation that has been created by alternating end-of-life tyres (ELT) recycled rubber pads coated with ultrathin films of graphene nanoplatelets (GNP). It is envisioned that this new material will have the ability to dissipate the energy of mechanical waves, which would otherwise radiate from sources of vibration (such as moving vehicles or machinery).

The student will be trained to use the state-of-the-art facilities available at the University of Exeter (UoE) to deposit graphene on recycled rubber pads and other substrates such as fibres. Further training will allow the student to use hot-press machines to cure specimens to create a range of prototypes of Graphene Reinforced ELastomeric (GREL) bearings. The project will then move into using dynamic testing equipment to examine the variations of the compound behaviour in response to changes in material properties and geometry under a variety of dynamic loads (e.g. shear and compression). The data collected will be analysed to identify the conditions needed to create a low-carbon and economically attractive isolation bearings.

Candidate requirements: Background in Engineering or Physics and interest for innovative environmentally friendly materials.

Background reading:

Rivera ED, Londoño Monsalve J, Craciun MF, Marsico MR. (2023) Experimental Assessment of the Mechanical Performance of Graphene Nanoplatelets Coated Polymers, Advanced Engineering Materials, volume 25, no. 23, DOI:10.1002/adem.202300830.

Marsico MR, Londoño Monsalve JM, Shin D-W, Craciun MF. (2020) Graphene–Rubber Layered Functional Composites for Seismic Isolation of Structures, Advanced Engineering Materials, volume 22, no. 7, DOI:10.1002/adem.201900852.

Approximate Work Schedule in weeks (desk based/lab/report writing)

Week 1 – Desk based: background reading / risk assessments / lab inductions.
Week 2-4 – Lab based work: Training on using spray coating and hot-press machine. Prototyping.
Week 5-6 – Lab based work: Training on using testing machines and data collection.
Week 7 – Desk/Lab based: Data analysis and further tests where needed.
Week 8 – Report writing