DESCRIPTION FOR THE GENERAL PUBLIC

The project TIGeR (Tensegrity-Inspired Graded metamateRials) is dedicated to the study on the dynamic response of graded tensegrity-inspired cellular metamaterials with extremal properties (Fig. 1), aimed at the application in various vibration damping systems. The main focus will be put on two aspects: 1) development of an algorithm that will be used for the description of the dynamic response of the investigated lattices, which will account for various properties of particular sub-regions of graded cellular system; 2) experimental testing of the dynamic response of graded tensegrity-inspired lattices produced with the use of an additive manufacturing technology (3D printing) under different types of dynamic loads. Graded lattices provide much greater modelling possibilities, especially if dynamic aspects are considered.

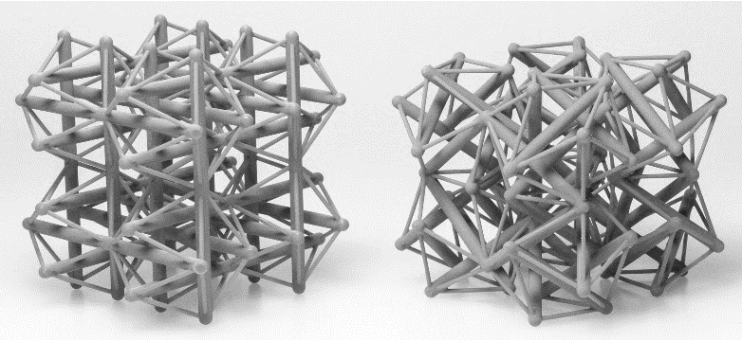

Fig. 1. 3D-printed tensegrity-inspired lattices: stiff (left) and soft (right) configuration.

Contemporary sustainability policies focus on the development of novel technologies with limited environmental impacts and improved efficiency, aimed at achieving human well-being and comfort. Despite enormous efforts put in the development of novel, ecological construction materials, most of the currently applied materials, including the ones used in vibration isolation systems, are still pollutant and require high energy consumption. In lightweight systems, such as tensegrity-inspired lattices proposed in this project, structural stability is provided by the architecture of the system rather than by the properties of parent materials. This is why, lightweight sustainable materials can be used instead of traditional ones. The long-term goal is to develop sustainable vibration isolation elements that will help reduce the transmission of vibrations to sensitive equipment, occupants, and neighbouring buildings, ensuring safety and comfort, contributing to healthier, more liveable environments, and improving the overall quality of life for communities.

Assumed effects of the project:

- development of an algorithm for the identification of the dynamic response of graded tensegrity-inspired cellular lattices with extremal properties under impulsive loads;
- development of minimum two configurations of graded tensegrity-inspired metamaterials designed for specific civil engineering applications with full computational and experimental verification.

Experimental tests will be carried out on specimens of graded tensegrity-inspired lattices, produced with the use of additive manufacturing technology (3D printing). All specimens will be manufactured at the Faculty of Civil Engineering of the Warsaw University of Technology and tested in two test stands: universal testing machine (for vertical loads) and shake table (for horizontal excitations). The considered systems will have a cellular structure and will be based on regular tensegrity modules with varying geometrical proportions, different arrangement patterns, varying stiffness. Various ways of achieving gradient properties will be analysed and an influence of graded mechanical properties on the dynamic response of the whole system will be investigated.