DESCRIPTION FOR THE GENERAL PUBLIC

The project is devoted to the development of a novel structural element whose properties can be controlled, even at the operational stage. The element will be made using sandwich plates technology. It will consist of two facings and an inner core. The facings will be made of wood or wood-based materials, while the interior of the structure (core) will be made of tensegrity structure. The proposed structure is intended to be an answer to numerous problems of contemporary engineering, such as the need to obtain a high bearing capacity in relation to its mass, minimizing the impact of construction on the environment or reconciling the safety of building use with often creative and spectacular designs.

The choice of wood as the main building material is due to its many advantages, which are lightness, durability, and low environmental impact compared to other building materials. Wood can be used in construction both as a solid material and in the form of wood-based materials such as OSB or plywood, which are commonly used in framing construction, among other applications. In addition, gluing techniques make it possible to produce glued laminated (Glulam) and cross laminated timber elements (CLT), which make it possible to erect high-rise structures such as the Mjøstårnet skyscraper in Brumunddal, Norway, which was commissioned in 2019.

However, the use of wood alone is not enough to meet current requirements. In the present project, it was decided to incorporate a smart structure element into the sandwich panel. Smart structure is characterised by properties that can adapt to the loading conditions. Such structures are tensegrity, which are able to stiffen under increasing loads due to the pre-stressing that occurs inside. Tensegrity structures are used in bridges and footbridges, for example, so that the user does not experience increased deflection under increased traffic. Furthermore, it is possible to externally control the properties of such a structure by changing the pre-stressing forces.

The combination of the advantages of these two elements: wood and tensegrity make it possible to obtain a structure that will not only show greater strength while maintaining low weight, but at the same time it will be possible to control its properties during use. The structural element developed during the project, along with its mathematical description, will be tested and verified experimentally.

The course of the project was divided into three stages. In the first stage of implementation, it is planned to develop a material model of the facing of the element, to be used in subsequent stages during the modelling of the sandwich element. The second stage of the project provides for the development of a tensegrity structure from which the core will be made. In the next step, a theoretical model of the sandwich element will be built to enable its analysis and geometry selection. In the third step, a physical model of the plate will be made, with the geometry determined from the theoretical model. The primary objective of this stage is to verify and validate the veracity of the models developed in the previous two parts of the project. It is planned to study the response of the structure to non-destructive loads, with outer layers made of different wood elements, different core geometries and its compression levels. The tests will allow to verify the proposed theoretical model and to choose the best element configuration. As a result, the geometry of the structural element suitable for civil engineering applications will be proposed, together with its mathematical description.