

The aim of the project is the comprehensive, interdisciplinary research of the traditional carpentry joints in the following aspects: historical, architectural, geometric, technological, static and strength. The study will include detailed geometric measurements of the authentic connections together with a thorough assessment of the technical state, laboratory tests using modern testing devices and non-linear numerical analysis. The project will also compare the results obtained in these studies with respect to the real state of carpentry joints.

The project will be carried out in four stages. In the first stage of the project, geometric measurements of the joints will be performed with the stocktaking of damage and the measurements of the physical properties of wood in preserved historic wooden buildings. In next stage, the laboratory tests of the carpentry joints systems, made using traditional methods in real scale, will be performed. Strength tests will be executed using the testing machine, owned by the Department of Structural Mechanics of Technical University of Gdansk, adapted to study the joints working in 3D. In order to determine the anisotropic material parameters of wood, appropriate laboratory tests will be carried out. Next, the finite element models (solid model) of the carpentry joints will be defined. Calculations will be conducted in the geometrically non-linear range including contact and friction effects. In the last stage, the numerical results will be verified by the laboratory tests and compared with carpentry joints behavior observed in the real wooden objects.

The project is interdisciplinary and its realization is possible in the collaboration of specialists representing the following areas: architecture, engineering and carpentry including specialists involved in the testing physical and mechanical properties of materials and finite element modeling. The project contains a unique, original experimental work using modern and world-unique research methods at the specially designed experimental stand. The innovative result of the research will be: to recognize the actual carpentry joints' work, to determine the parameters affecting their persistence. Thus far, such complex studies have not been conducted yet, and they are fundamental for the description of the mechanical behavior as well as the work conditions of carpentry joints in historical buildings and modern wooden structures. The literature concerning such joints does not provide any comprehensive, methodological research, nevertheless some discussions of individual aspects of the problem, usually at an early stage are available. The implementation of the project will raise the level of basic knowledge about the carpentry joints and indicate the paths to search for modern, optimal carpentry joint, possible to use in modern engineering structures. The study is of great importance for the development of wooden architecture. The basic knowledge will be summarized in the form of a monograph, where the way of carrying out the research by a group of art restorers and the specialists in the field of solid mechanics will be presented.