

Correlation between destructive and four NDT techniques tests on historic timber elements

Vlatka Rajčić¹, Camilla Cola²

Abstract The paper presents results from the wide experimental campaign of NDTs on ancient timber roof structure of Palace Malvezzi (Bologna) dated before 20th Century in situ and in laboratory, using several different techniques (visual inspection, 4-point bending test, ultrasound test, moisture content test, drilling penetration resistance, spectral analyser, ground penetrating radar test together with comparative laboratory destructive and NDTs on the ancient timber beams 256 cm long and on samples cut from them which were dismantled from the roof of a historic residential building, of the same botanical species (spruce) dating from the same period as timber roof structure of Palace Malvezzi. Moisture content of ancient timber beams has been varied to check its influence on mechanical properties. Modulus of elasticity was obtained on 4 full-scale beams (13/14x256 cm³) by 4-point bending test but also by ultrasound testing and by spectral analyser. Compression strength was obtained on 25x25x100 mm³ samples and bending strength was obtained from the historic timber samples of 25x25x400 mm³. Local weak points (decay, knots, splits, joints) were determined on site and in the laboratory by visual inspection and by testing via penetration drilling resistance and ground penetration radar. Samples were tested parallel and perpendicular to grain.

On site testing was carried out first by visual inspection, afterwards by measuring modulus of elasticity by four point on site bending test to obtain realistic values of the modulus of elasticity, comparative measurements using ultrasonic device, measuring moisture content and drilling penetration resistance. A correlation between NDTs parameter and results from destructive tests of compression, tensile and bending strength is obtained by statistical analysis of the data obtained on site and in laboratory and presented in order to propose a methodology for obtaining accurate mechanical properties of the material, residual bearing capacity and stiffness of timber elements.

Influence of the moisture and stress level in element are examined and correlation between NDT parameters, static MOE and strengths obtained by destructive testings are determined. Experimental campaign has been designed, developed and financed inside the EU FP7 project SMooHS (Smart Monitoring of Historic Structures) (2008-2011) by partners from University of Zagreb and University of Bologna.

Keywords historic timber structures, destructive test, NDT techniques, residual mechanical properties testing, in situ, laboratory, correlations

¹ Vlatka Rajčić, Faculty of Civil Engineering, University of Zagreb, Croatia, vrajcic@grad.hr

² Camilla Cola, Faculty of Engineering, University of Bologna, Italy,

