Stand for research of wood swelling pressure in two axes simultaneously

Paweł Bachman, Marcin Chciuk

Faculty of Mechanical Engineering, University of Zielona Góra, Poland

Abstract: This paper describes a method for measuring wood swelling pressure simultaneously in two axes. Construction of the modern research stand, results of the measurements and the measurements comparison in one and in two axes at the same time are shown.

Keywords: measuring wood swelling pressure

1. Introduction

Wood swelling pressure is the pressure at the obstacle caused by the moisture treated wood. Swelling wood causes big forces which may bring about destruction of wooden structures exposed to moisture or water. First swelling forces research took place in the 30s and 40s of XX century [1, 2]. On example of pine, it was found experimentally that the swelling pressure of the tangential and radial direction of the wood is different, which is connected with its anisotropic structure. In previous studies, to determine the forces caused by swelling wood lever mechanism was used. In this mechanism swelling wood pressed the spring arm with a known deformation (e.g. 0.02 mm to 100 N). Deformation measurement was made by micrometer with precision 0.001 mm [3]. The study was conducted for wood samples of size $20 \times 20 \times 30$ mm and the humidity 30 % [3].

The studies revealed that the tangential pressure (Y in fig. 1) is always greater than the radial one (X). These measurements were made, for only one axis at a time. The situation, when the timber is limited only in one axis is very sporadic. The most frequent cases are the structures in which the timber is simultaneously compressed in the radial and tangential direction. An example would be a wooden floor or a beam mounted in the wall. No one investigated, how behaves wood sample exposed to moisture in two axes at the same time. Because of the fact that there was a lack of any publications on the subject, in this paper the construction of the measuring stand and results of research on this issue are presented. Using modern techniques of data acquisition also test stand was modified. Tensometers and measuring PC card were used for the measurements.

2. Construction of a measuring stand

Measurement stand was based on two tensometers KMM30-5kN. They are fitted together with the wood sample of size $35 \times 35 \times 35$ mm into the measurement frame. Wood samples were dried prior to testing in the oven to achieve humidity below 10 %. The whole sample was immersed in distilled water, corresponding to a relative humidity of 100 %. To prevent wetting the tensometers and measure force of the entire surface of the sample, steel spacers were used.

Signal is send from the sensors via measuring amplifiers to analog inputs of PCI card DaqBoard 3000 (fig. 2) and to the software for data acquisition. Signal samples were collected with frequency 0.1 Hz. Wood samples were mounted with an initial force 100 N.

View of measuring apparatus is shown in fig. 3.

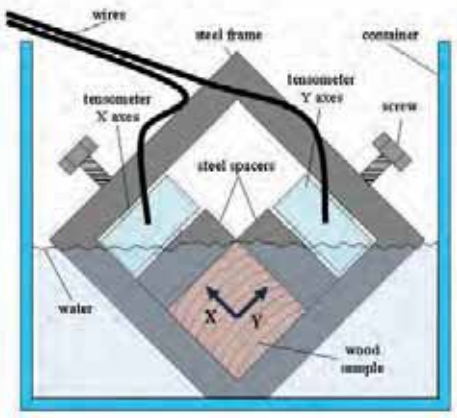

Fig. 1. Schematic diagram of measurement system
Rys. 1. Schemat układu pomiarowego

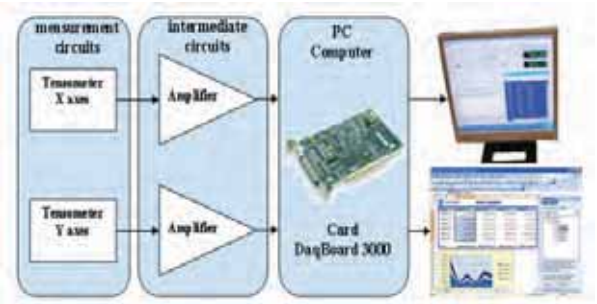

Fig. 2. Schematic diagram of measurement-acquisition system
Rys. 2. Schemat układu pomiarowo-rejestrującego

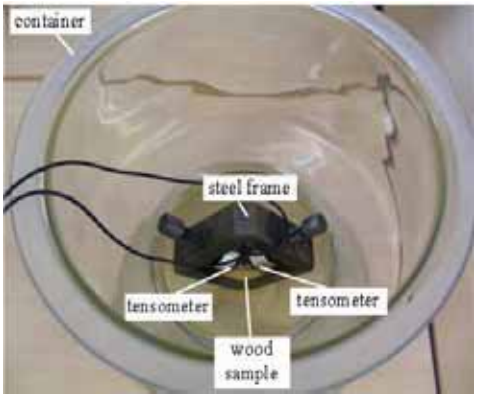

Fig. 3. View of the measuring apparatus
Rys. 3. Widok stanowiska badawczego

3. Results

The main point of the research was to examine, whether research station will allow observing the difference in swelling pressure in the tangential and radial direction, with measurements made at only one axis or two axes at the same time. For the study were carried out three tests:

1. Pressure measurements in the radial direction and free swelling in tangential direction (fig. 4).
2. Pressure measurements in the tangential direction and free swelling in the radial direction (fig. 5).
3. Measurement of wood swelling pressure in two axes at the same time (fig. 6).

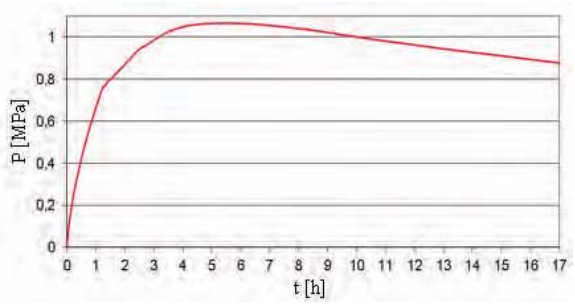

Fig. 4. The results of measurements of pressure in the radial direction and free swelling in tangential direction

Rys. 4. Wyniki pomiarów ciśnienia w kierunku promieniowym, przy swobodnym pęcznieniu w kierunku stycznym

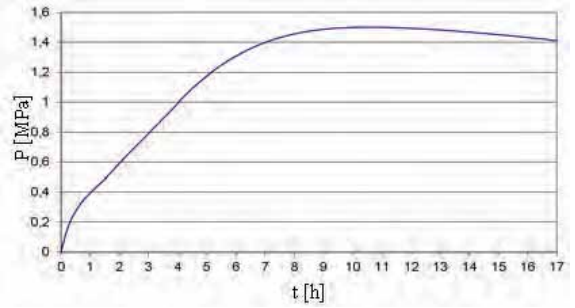

Fig. 5. The results of measurements of pressure in the tangential direction and free swelling in radial direction

Rys. 5. Wyniki pomiarów ciśnienia w kierunku stycznym, przy swobodnym pęcznieniu w kierunku promieniowym

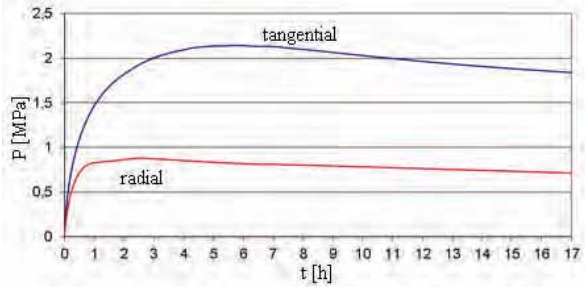

Fig. 6. The results of measurements of pressure in two axes at the same time

Rys. 6. Wyniki pomiarów ciśnienia w dwóch osiach jednocześnie

4. Conclusion

Based on measurements, it can be concluded that the test stand serves its purpose. It enables observation of differences in the swelling pressure between the measurements performed only for one axis and for two axes simultaneously. Comparing the results of the measured samples in one axis, found in the scientific literature, it can be concluded, that they are similar to obtained from the present measurement stand. Differences occur only in the values of pressure that may be related to other size of the wood samples. It can be noticed during the measurements in two axes at the same time, that the pressure has increased in the tangential direction by about 0.7 MPa, and decreased in the radial direction of 0.2 MPa, as compared to the measurement in one axis. These results seem to be very interesting and they require further research.

References

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Stanowisko do badań ciśnienia pęcznienia drewna w dwóch osiach jednocześnie

Streszczenie: W artykule opisano metodę pomiaru ciśnienia pęcznienia drewna w dwóch osiach jednocześnie. Pokazano też budowę nowoczesnego stanowiska badawczego, wyniki pomiarów i porównanie pomiarów ciśnienia pęcznienia w jednej i w dwóch osiach jednocześnie.

Słowa kluczowe: pomiar ciśnienia pęcznienia drewna

Marcin Chciuk, MSc

Assistant at the Institute of Education Technology and Computer Science, Faculty of Mechanical Engineering, University of Zielona Góra. Interests: mechatronics and control systems.
e-mail: M.Chciuk@eti.uz.zgora.pl

Paweł Bachman, MSc

Assistant at the Institute of Education Technology and Computer Science, Faculty of Mechanical Engineering, University of Zielona Góra. Interests: mechatronics and control systems. Scholarship in Sub-measure 8.2.2 "Regional Innovation Strategies", Measure 8.2 "Transfer of Knowledge", Priority VIII "HR Regional Economy" Operational Programme Human Resources co-funded by the European Social Fund, the European Union and the state budget.
e-mail: P.Bachman@eti.uz.zgora.pl