

Application of Pro-Ecological Building Technologies in Contemporary Architecture

Jerzy Górski¹, Joanna Klimowicz² and Anna Nowak³

¹ Warsaw University of Technology, Faculty of Architecture, Department of Structure Design, Construction and Technical Infrastructure, Koszykowa 55, 00-661 Warsaw, Poland, jerzy.gorski@pw.edu.pl

² Warsaw University of Technology, Faculty of Architecture, Department of Urban Design and Spatial Planning, Koszykowa 55, 00-661 Warsaw, Poland, joanna.klimowicz@pw.edu.pl
klijo@poczta.onet.pl

³ Warsaw University of Technology, Faculty of Architecture, Department of Structure Design, Construction and Technical Infrastructure, Koszykowa 55, 00-661 Warsaw, Poland, anna.patrycja.nowak@gmail.com

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1 Introduction

In modern pro-ecological architecture, many trends can be identified, which lead to the design of architecture in accordance with the idea of sustainable development. One of them is circular design. The main assumption in this design approach is to use materials that can be obtained in close proximity to the design area, with the possibility of their reuse, or using bio-materials. According to this, structural and material solutions of modern buildings are an important element of considerations in accordance with the idea of sustainable design, in which the aim is to minimize their negative impact on the environment. These searches turn towards low-tech technology, which uses natural and low-processed materials, which are possible to obtain in selected locations. Construction in the raw earth technology is a modernization of the traditional technology, in which it is possible to apply pro-ecological values associated with the used material. The use of earth as "waste" from the excavated material after excavation of the foundations of the building, for the construction of external and internal walls of the designed object is an important element inscribing the project in the idea of circular design. The paper presents research on insulation properties of walls in an experimental earth building located in Pasłęk in Poland. The aim of the research was to determine the potential of the applied raw earth technology in a local climate.

In an experimental building described below located in the Ecological Park in Pasłęk in Poland the following types of raw earth technologies were used: rammed earth in formwork, earth pressed blocks, strew clay blocks and clay render. The project was carried out at the Faculty of Architecture of the Warsaw University of Technology by the team: prof. Teresa Kelm, arch. Jerzy Górski PhD, arch. Marek Kołataj, Dorota Długosz-Nowicka PhD, who cooperated on technological issues and carried out laboratory tests. Structures and installations designers participated in the preparation of the Construction Design. Preparation of the project and construction of the building became possible thanks to the grant from the Ministry of Science and Higher Education in the years 2005 – 2008, involvement of the city authorities of

Pasłek and with the help of sponsors. The building was commissioned in 2012. and handed to the city.



Figure 1. Left and in middle: View of the experimental earth building located in the Ecological Park in Pasłek. Right: The inside of the veranda. Wooden structure glazed with low-emission composite panes. On the right there is an accumulation wall made of compacted raw earth and a door connecting with the main hall.

Researches were divided into three parts: measurement of wall moisture (using TROTEC BM 22) in summer and in autumn, measurements of room temperature and humidity (using Testo 410-2) in summer and in autumn, and research with thermal camera (using SeeK Thermal) in autumn. The results of the research were taken to analysis of energy efficiency of the building. Based on the results design solutions were proposed.

ORCID

Jerzy Górski: <http://orcid.org/0000-0002-4583-8144>

Joanna Klimowicz: <http://orcid.org/0000-0003-4950-3250>

Anna Nowak: <http://orcid.org/0000-0003-2952-904X>

References

- Ashour T., Heiko G. and Wei W. (2011). An experimental investigation on equilibrium moisture content of earth plaster with natural reinforcement fibres for straw bale buildings. *Applied Thermal Engineering*, 31(2-3), 293-303.
- Dobson S. (2000). *Continuity of Tradition: New Earth Building Terra*
- Ford M., Griffiths R. and Watson L. (2005). The Sandford Inventory of Earth Buildings constructed using a GIS *Building and Environment*, 40(7), 964-972.
- Górski J., Klimowicz J., Kołtątaj M. and Nowak A. (2018). *Mikroklimat obiektów jako efekt zastosowania proekologicznych technologii budowlanych* (in Polish), statutory work at the Faculty of Architecture in the Warsaw University of Technology, Warsaw, Poland.
- Górski J., Kelm T., Klimowicz J. and Kołtątaj M. (2017). *Architektura ziemi i zielona infrastruktura* (in Polish), statutory work at the Faculty of Architecture in the Warsaw University of Technology, Warsaw, Poland.
- Kelm T. (1996). *Architektura ziemi – tradycja i współczesność*. (in Polish) Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw, Poland.
- Niroumand H., Zain M. F M and Jamil M. (2013). *A guideline for assessing of critical parameters on Earth architecture and Earth buildings as a sustainable architecture in various countries*. *Renewable and Sustainable Energy Reviews*, 28, 130-165. doi: 10.1016/j.rser.2013.07.020
- Nother B. (1996). *Looking after earth buildings* *Context*, (49), 22-23.
- Thiers S. and Peuportier B. (2008). *Thermal and environmental assessment of a passive building equipped with an earth-to-air heat exchanger in France* *Solar Energy*, 82(9), 820-831.
- Wallis R.K. (2012). *Modern Earth Buildings Elsevier*, 688-71.