

UDC 621.988:72/7

ADDITIVE TECHNOLOGIES: POTENTIAL AND FUTURE APPLICATION IN DESIGN AND ARCHITECTURE

**Dmytro Itchenko**, PhD in Technical Sciences  
*National University “Chernihiv Polytechnic”*

[itchenko@stu.cn.ua](mailto:itchenko@stu.cn.ua)

**Olga Gavryk**, PhD Candidate  
*National University “Yuri Kondratyuk Poltava Polytechnic”*

**Dmytro Tkachuk**, Master’s Degree Student  
*National University “Chernihiv Polytechnic”*

**Oleksandr Hryhorenko**, Bachelor’s Degree Student  
*National University “Chernihiv Polytechnic”*

**Relevance of the research.** Additive Technologies (AT), or 3D printing, are rapidly changing approaches to planning in architecture and design, as they enable people to create complex shapes, optimise structures, and reduce production costs. Modern studies emphasise that due to their high precision AT help to create shapes that cannot be produced using traditional methods, [2, 3]. In the architectural field, 3D printing demonstrates a significant potential in producing building elements, experimental structures and large objects [4]. In design, additive technologies are actively used for creating unique items, prototypes, and innovative interior solutions, which significantly expands people’s creative capabilities [4].

The role of AT in the modelling and reconstruction of architectural objects remains important: 3D printing ensures fast and accurate reproduction of models and optimises research and educational process [1]. Technical progress in polymeric materials and 3D printing equipment also expands the sphere of applying technology into professional design and architectural practices [3].

Thus, additive technologies are an important factor in innovative development and open up new prospects for the form formation, planning, and material experimentation in design and architecture.

**The purpose of the study** is to determine the potential of additive technologies in the reproduction of wooden architecture objects of the 18th century in the Chernihiv region, namely: the Holy Trinity Church (Pakul village), the Church of the Ascension of the Lord (Berezna village), and the Church of the Nativity (Sheptaky village), as well as to assess the effectiveness of 3D printing for scientific reconstruction, physical modeling, and the overall preservation of cultural heritage in the context of architecture and design.

**Methodology and organisation of the study.** The study was conducted using a comprehensive approach, which combines theoretical analysis and the practical application of additive technologies in the reproduction of 18th-century wooden architecture in the Chernihiv region. Three monuments that present Chernihiv wooden architecture of the mentioned period were selected. The Holy Trinity Church in Pakul village (1710) demonstrates a harmonious combination of the vertical orientation of the church volumes and soft wall modelling; its proportions and the stepped composition of the domes testify to the high skill of local carpenters (Fig. 1.1 a) [5]. The Church of the Ascension of the Lord in Berezna village (1759–1761) is an example of a five-part composition with a clear structural scheme and a balanced silhouette (Fig. 1.1 b) [5]. The Church of the Nativity in Sheptaky village (1774) is distinguished by the simplicity of its volumetric structure emphasised verticality, and restrained wall plasticity (Fig. 1.1 c) [5].

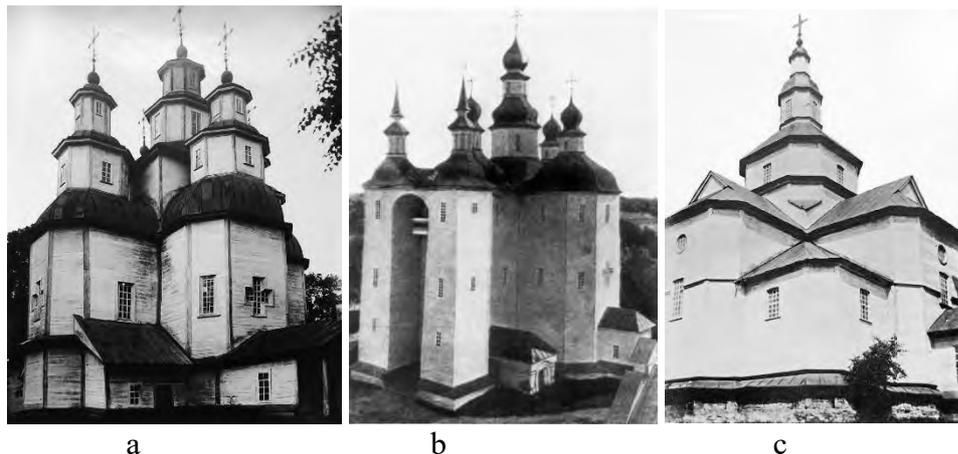


Figure 1.1 – Objects of the 18th-century wooden architecture in the Chernihiv region

Based on historical sources, photographs, and drawings, detailed **3D models** were created in CAD programs for each object. The modelling covered the reproduction of the proportions and decorative elements of the monuments [1]. The prepared models were optimised for 3D printing, and the samples were made of polymeric materials with high detail accuracy, which enabled to reproduce the studied wooden monuments that have not been preserved and visualise them in physical form [5].

**Results of the study.** The study showed that all three objects were reproduced with high accuracy of forms, proportions, and decorative details. The comparison of 3D models with historical data indicates that additive technologies enable researches to reconstruct even those elements of the structures that have not been fully preserved, providing a clear visual presentation of their architectural structure and volumetric composition (Fig. 1.2 a, b). Figure (1.2 c) illustrates the model of the Church of the Nativity in Sheptaky village during the assembly process, which clearly demonstrates the stages of the monument’s reproduction.

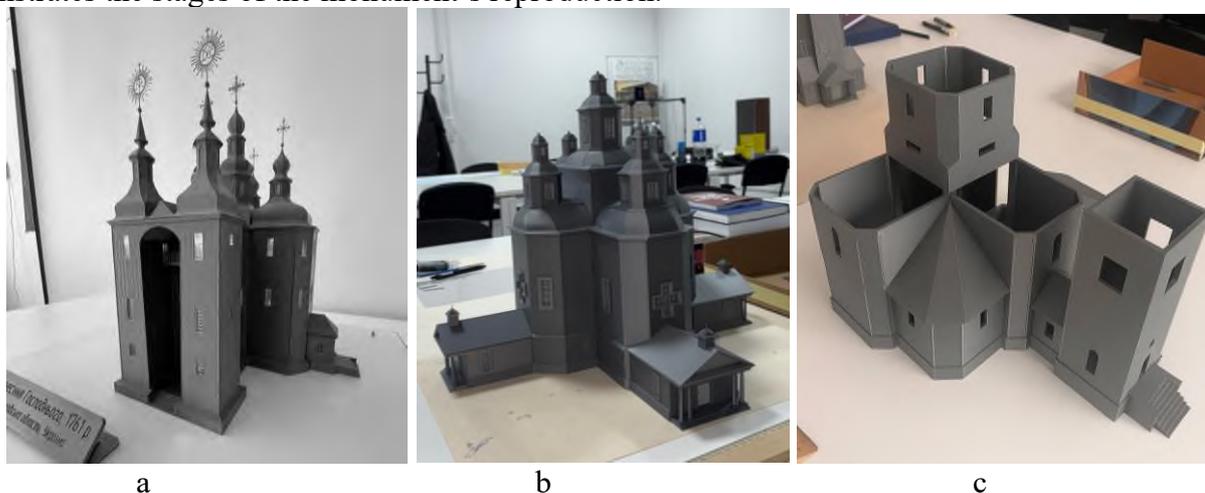


Figure 1.2 – Printed models of the studied 18th-century wooden architectural monuments in the Chernihiv region (a - Church of the Ascension of the Lord in Berezna village, b - Holy Trinity Church in Pakul village, c - Church of the Nativity in Sheptaky village) (Photos taken by the authors)

The printed samples demonstrated the efficacy of 3D printing as an instrument for the scientific reconstruction and modelling of wooden heritage, enabling detailed analysis of proportions, structural designs, and artistic design [2, 3].

Moreover, the produced models can be used in the educational process and museum practice, which makes them an important means for promoting and preserving cultural heritage. The illustrations of 3D models clearly demonstrate the results of the work and confirm the potential of

additive technologies as a modern tool in architecture and design, opening up new opportunities for research, reconstruction, and visualisation of historical objects [4].

**Conclusions.** Additive technologies (3D printing) demonstrated high effectiveness in reproducing objects of the 18th century wooden architecture in the Chernihiv region, enabling to reproduce the forms, proportions, and decorative elements of the monuments accurately. The created 3D models and church samples demonstrated the potential to reconstruct structures that have not been preserved. The study confirmed that additive technologies open up new prospects for the innovative development in architecture and design, combining historical accuracy with modern approaches to visualisation and material experimentation.

*References:*

1. Koshil, M. V., Tkachuk, D. V., & Itchenko, D. M. (2025). Vykorystannia adytyvnykh tekhnolohiy u maketuvanni arkhitekturnykh ob'ektiv: perevahy, vyklyky ta perspektyvy [The Use of Additive Technologies in Architectural Object Modeling: Advantages, Challenges, and Prospects]. In *Yunist Nauky-2025 [The Youth of Science]*. Pyatnadtsiata Mizhnarodna Naukovo-praktychna Konferentsiia Studentiv, Aspirantiv ta Molodykh Uchenukh. [Proceedings of the 15<sup>th</sup> International Research Conference for Students, Ph.D. Candidates and Young Researchers] (p. 981). Chernihiv, Ukraine.

2. Androshchuk, H. O. (2017). Adytyvni tekhnolohii: perspektyvy i problemy 3D-druku [Additive technologies: prospects and problems of 3D printing]. *Nauka, Tekhnolohii, Innovatsii [Science, Technology, Innovations]*, 1, 68-77.

3. Ivanov-Kostetskyi, S. O., Humennyk, I., & Voronkova, I. (2018). *Adytyvni tekhnolohii: navch. posib.* [Additive technologies: Study guide]. Vinnytsia, Ukraine: VNTU.

4. Subin-Kozhevnikova, A., Khorosha, O., & Oliinychenko, V. (2023). Osoblyvosti ta perspektyvy vykorystannia adytyvnykh tekhnolohiy v arkhitekturi [Features and prospects of using additive technologies in architecture]. *Suchasni Problemy Arkhitektury ta Mistobuduvannya [Modern Problems in Architecture and Urban Planning]*, 62, 241-248.

5. Taranushenko, S. A. (2014). *Derevyana monumentalna arkhitektura Livoberezhnoï Ukraïny. Povna redaktsiya [Wooden Monumental Architecture of Left-Bank Ukraine. Complete Edition]*. Kharkiv, Ukraine: Vydavets Savchuk O. O.

**УДК 622.276.6**

**QUANTITATIVE ASSESSMENT OF ROBUSTNESS OF OIL DISPLACEMENT EFFICIENCY PREDICTION METHODS**

**Olena Martus**, postgraduate student

**Branimir Cvetkovic**, profesor. PhD

*National University «Yuri Kondratyuk Poltava Polytechnic»*

*Introduction.* The inaccuracy of analytical forecasting of Oil Displacement Efficiency ( $E_D$ ) using standard methods (GSTU, classical Buckley-Leverett) is largely associated with geological uncertainty and the inadequate response of models to the integration of detailed input information. This research identifies a philosophical dilemma between two model classes: Empirical GSTU Model and Physically-Based Buckley-Leverett Model [1 - 2]. Empirical GSTU Model (“Black Box”) is Simple and fast, but contains empirically derived correction coefficients that can suppress uncertainty. Physically-Based Buckley-Leverett Model (“White Box”) is Complex, based on fundamental equations, more transparent, and sensitive to input data quality [3 - 4].

The goal of this work is to develop and test a structured methodology for the quantitative assessment of a fundamental property of these models—their robustness (stability) to the integration