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A CASE STUDY ON THE CONSTRUCTION TECHNOLOGY AND ENERGY EFFICIENCY OF RESIDENTIAL HOUSING MADE OF BIO-COMPOSITE MATERIALS

The article considers the relevant topic regarding application of bio-composite hempcrete-based materials as the ecologically friendly, more energy efficient and resource keeping alternative to traditional ones. Such a "green" construction practices allow to reduce significantly global CO₂ emission, resource depletion creating stimulating environment for its inhabitants during all building's life cycle. Implementation of hempcrete in Ukrainian construction practices can be extremely beneficial in terms of post-war reconstruction when the demand for affordable housing will go up dramatically. At the same time, there are some challenges limiting the widespread hempcrete application related with the lack of systematic experience in implementing such facilities locally, the absence of engineering-focused descriptions of construction technology as well as high level of consumer's skepticism regarding the quality and durability of hempcrete-made buildings. Based on the real practical case of single-family residential housing the hemp-lime construction technologies were studied. The results of the thermal calculation of building's envelope has revealed that single-stud hempcrete wall formation technique with the thickness of 150...250 mm doesn't meet the Ukrainian regulatory requirements. The R-value of such walls doesn't exceed of 2.5...717 m²·K/W. In this context, to provide sufficient level of building's envelope thermal efficiency the interior-stud technique with the thickness of hempcrete walls of 400 mm and more is needed. Our calculations have shown that R-value of such walls reach up to 5.601 m²·K/W that provides a high level of energy efficiency and should be utilized in Chernihiv's Climate Zone.

Keywords: Sustainability; eco-construction; green building; hempcrete; thermal efficiency; construction technology.

Fig.: 10. **References:** 17.

Urgency of the research. The environmental challenges of modern construction, related with greenhouse gas emissions, high-energy consumption and depletion of non-renewable resources, require a radical transformation of the construction sector [1].

The demand to decarbonize, enhance the energy efficiency of modern buildings, and implement circular economy principles has sparked researchers and practitioners' interest globally in safer, more sustainable, and environmentally friendly alternatives for construction materials [2]. Such an intentions were institutionalized through international certification systems implementation, such as LEED (USA), LBC (USA), DGNB (Germany), and BREEAM (UK), as well as others European programs aimed at decarbonizing the building stock [3].

Target setting. In this context, bio-based composites, particularly hemp-lime, widely known as hempcrete, are positioned as a renewable and potentially carbon-absorbing alternatives to traditional insulations and other construction materials [4]. Over the past two decades, hempcrete has been actively researched as a promising material for low-rise residential, as well as public buildings where structural loads are moderate and environmental performance plays essential role.

It is worth noting that the application of hempcrete aligns with the key principles of the European Green Deal (EGD), including reducing the carbon footprint, improving energy efficiency, and ensuring climate neutrality in the construction sector [5].

Construction practices using hempcrete demonstrate compliance with all these criteria: it has low energy consumption during production, the ability to continuously absorb CO₂ throughout its whole life cycle, high thermal insulation properties, and natural humidity regulation, which improve the indoor microclimate.

Actual scientific researches and issues analysis. Systematic reviews of recent scientific publications on hempcrete applications have shown that research mainly focuses on its thermo-physical properties [3; 6; 7], moisture exchange and ecological life cycle balance [8], assessment of its mechanical strength, as well as its environmental friendliness and carbon footprint [9; 10].

For modern Ukraine, facing rapidly growing demands for technologically simple, resource, and energy-efficient construction solutions, driven by the large-scale destruction of residential infrastructure because of ongoing war, construction practices using hempcrete may become one of the national trends.

On the one hand, Ukraine possesses significant agricultural potential for growing industrial hemp, on the other hand, it faces limitation of traditional building materials and its constant rising costs. In the post-war period, this may become a prerequisite for the development of local production chains: “raw materials – building materials – residential facilities” in which hempcrete can play a pivotal role.

However, the lack of systematic experience in implementing such facilities locally, the absence of engineering-focused descriptions of construction technology as well as any regulatory documents along with the high level of consumer’s skepticism regarding the quality and durability of hempcrete-made buildings hinders the broader adoption of this technology here in Ukraine.

The research objective. Thus, this article aims to systematically present existing hempcrete technologies, as well as the advantages and limitations of its application, based on the results of a real case study, and to determine the prospects for its further implementation in low-rise construction in Ukraine in the context of modern European environmental requirements.

The statement of basic materials. As it was abovementioned, hempcrete is a bio-composite that is made up of hemp hurd mixed with a lime-based binder and water (see Fig. 1). Depending on its mixture design, particularly shives-to-binder ratio, thermophysical and mechanical properties of hempcrete can vary significantly.

Normally, when it comes to the wall construction the prevalent hemp-to-binder ratio of 1:2 while hemp-to-water of 1:3 [11]. It has been established that an increase in lime in a hempcrete mix increases its compressive strength when its thermal efficiency goes down. According to [12], the mixture with the hemp-to-lime ratio of 0.25 (12% hemp, 49% lime, 39% water) shows better compressive strength at a level of 0.51 MPa compared to 0.83 hemp-to-lime ratio (24% hemp, 29% lime, 47% water) where compressive strength doesn’t exceed 0.07 MPa. At the same time, the mix with 0.83 hemp/lime ratio provides a better thermal performance with the thermal conductivity of 0.07 W/m·K versus 0.120 W/m·K for hemp-to-lime ratio of 0.25. This is exactly why hempcrete is utilized prevalently for a wall systems formation.

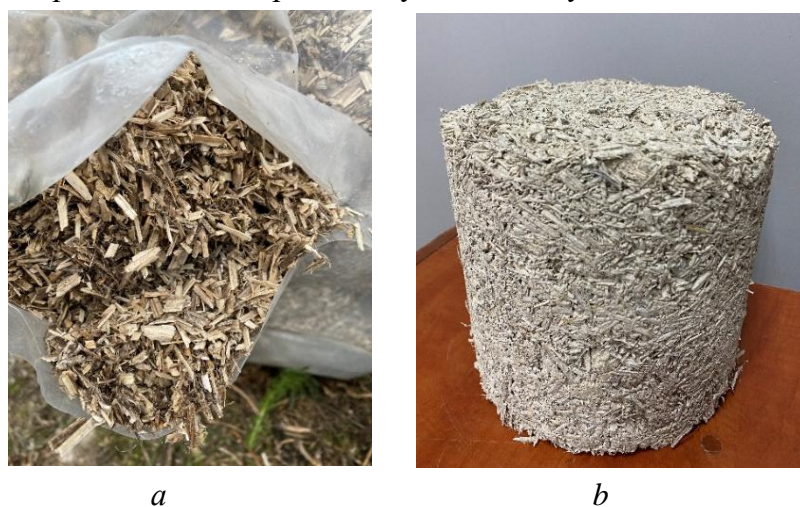


Fig. 1. External view of a hemp hurds (shives) (a), and hempcrete-made element (b)

Currently for hempcrete application projection-spraying method, cast-in-place or prefabricated blocks are widely utilized (see Fig. 2).

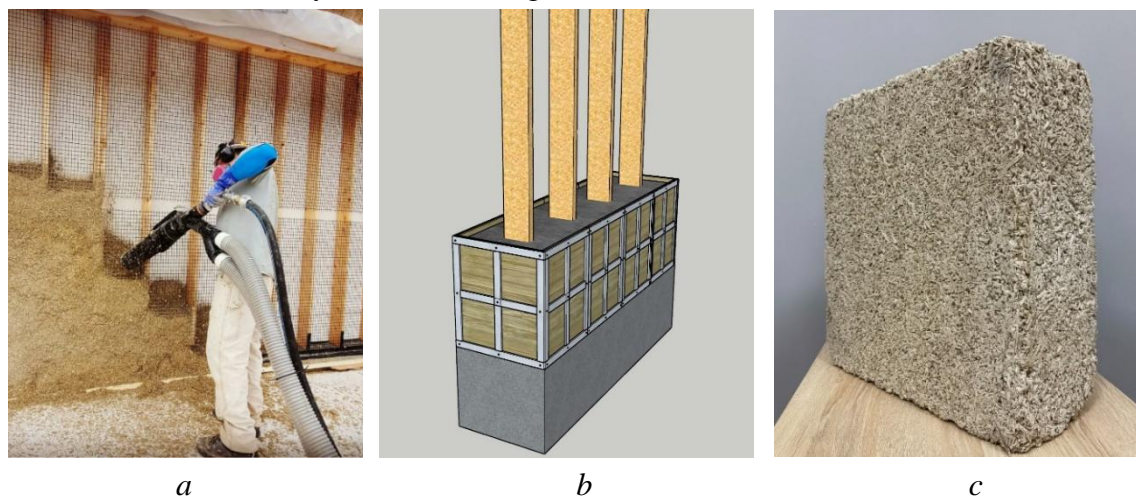


Fig. 2. Techniques of hempcrete application:

a – projection-spraying [13]; b – cast-in-place (or in-situ); c – prefabricated hempcrete blocks

During projection spraying process dry hemp and lime are supplied through the hose by means of pressurized air stream while water supply is provided through the separate water inlet of the same hose. The whole hemp-lime-water mixture is applied through the delivery nozzle of the hose to infill the mold assembled on the substrate (wall in particular) as shown in Fig. 2, *a*. For this occasion, the factory-made hempcrete mixes are used. As it was shown in [11], this method of hempcrete application can reduce significantly the total setting time as well as duration of construction as a whole. At the same time, the using of mechanized mixture delivery doesn't provide the high stability level of hempcrete quality with the high pores size disparity. The latter can lead to the increase in relative humidity of hempcrete that deteriorates dramatically of its thermal performances. On top of that, the highly trained operator is also required.

In-situ casting hempcrete process implies the hemp-binder-water mixing directly on construction site with the subsequent application into a formwork as given in Fig. 2, *b*. Normally, hempcrete casting around the timber-made structural frame to provide the bear-load capacity for the structure that is required. Typically, the 60 cm-tall OSB-3 shuttering with the thickness of 1.2-1.5 cm is used. Forced-action mixers with the size of 300...350 liters, as shown in Fig. 3, are widely utilized for mixture preparation. To achieve sufficient level of hempcrete compaction without voids and excessive porosity the application of external force is also needed [11].



Fig. 3. External view of the mixer for in-situ hempcrete preparation

It is noteworthy that cast-in-place technique doesn't required sophisticated and specialized technical equipment but the quality of the mixture and its application strongly depends on builders' expertise.

The construction practice using prefabricated hempcrete blocks that were manufactured in controlled factory environment with further transportation on construction site provides greater quality of hempcrete mixture with more predictable thermal and mechanical properties. The example of such a prefabricated hempcrete block is shown in Fig. 2, c. It should be noted that this specific block was provided to us by the company Hempire Ukraine. The dimensions of these can vary ranging from 500×300×200 mm to 600×300×400 mm. The thin blocks with a thickness of 70...150 mm are also used for interior applications. As the mortar, the lime-sand mixture is used [11]. The example of premanufactured hempcrete block building is shown in Fig. 4.



Fig. 4. Premanufactured hempcrete block building [12]

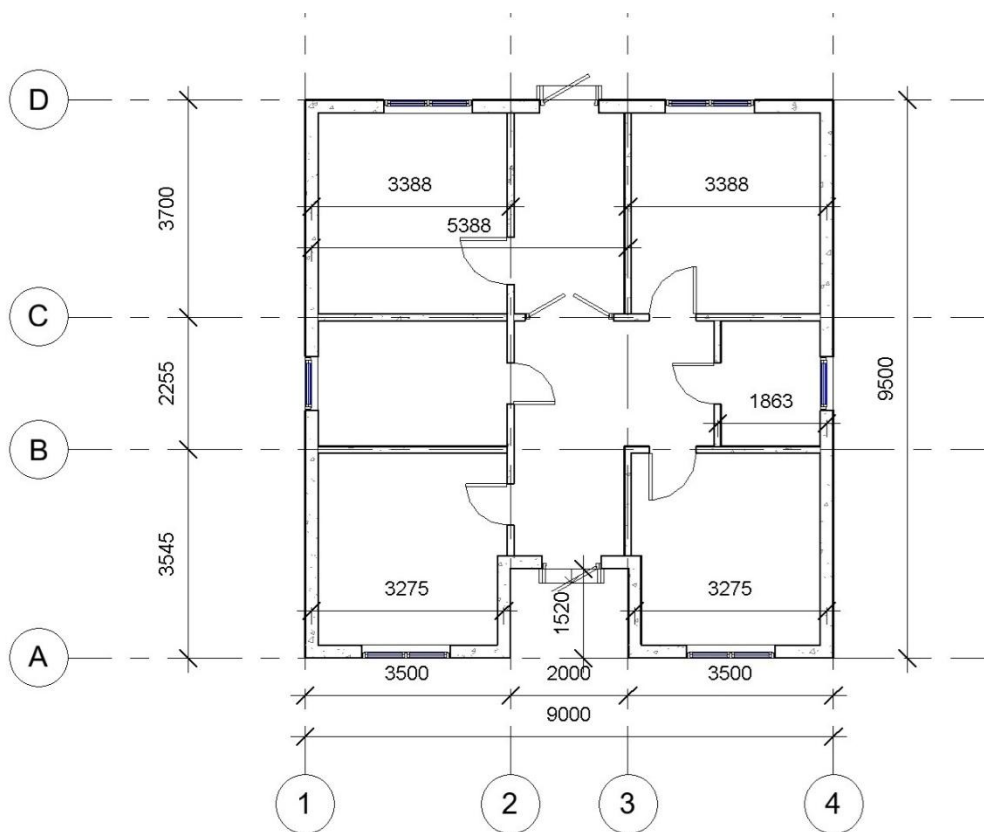
Our case study is focused on cast-in-place hempcrete application for construction of single-family residential house. The project is being implemented and supported by the Dutch foundation OpenDoorUkraine.nl (ODU) in a partnership with Hempire UA that is only one certified Ukrainian company regarding of binding materials production for hempcrete. According to the project, the building will have an area of 85 m² with the 60 m² of living space. The construction of this building that's situated in the vicinity of Chernihiv in the village of Novoselivka, commenced in the fall of 2024 and currently ongoing. To increase the accuracy of project realization the BIM-technology particularly Autodesk Revit 2026 software was used [14]. The external view of facades, its 3D-models as well as floor design are given in Fig. 5.



a



b



c

Fig. 5. External view and its 3D models of studied building:
 a – North-western façade; b – South-east façade; c – floor plan

Since it is known, the compressive strength of a hempcrete, generally, doesn't exceed 0.91 MPa regardless of mixture design, density, and form of its application [12]. It can't be utilized as a load-bearing material at all. In this case, it is used along with the structural framing, normally timber-made. In our case study, the timber studwork is made up of bottom plate of 50×150 mm; vertical studs of 50×150 mm are installed at a spacing of 400 mm; diagonal braces of 25×150 mm to ensure the spatial stiffness; and the top plate of 50×150 mm laid out in two layers with the total thickness of 300 mm to connect all vertical studs in one structural frame. 3D model of this frame and its cross-section are given in Fig. 6.

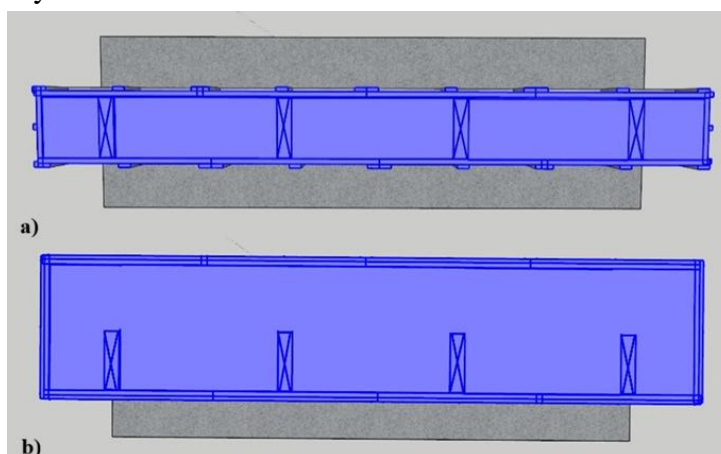
It is also noteworthy that wooden frame was built on monolithic foundation slab of 600 mm in thick that was previously covered with bituminous waterproofing membrane of 1 mm. Thus, the hempcrete exterior walls will be carefully protected from soil moisture, splashes of rain or snow.



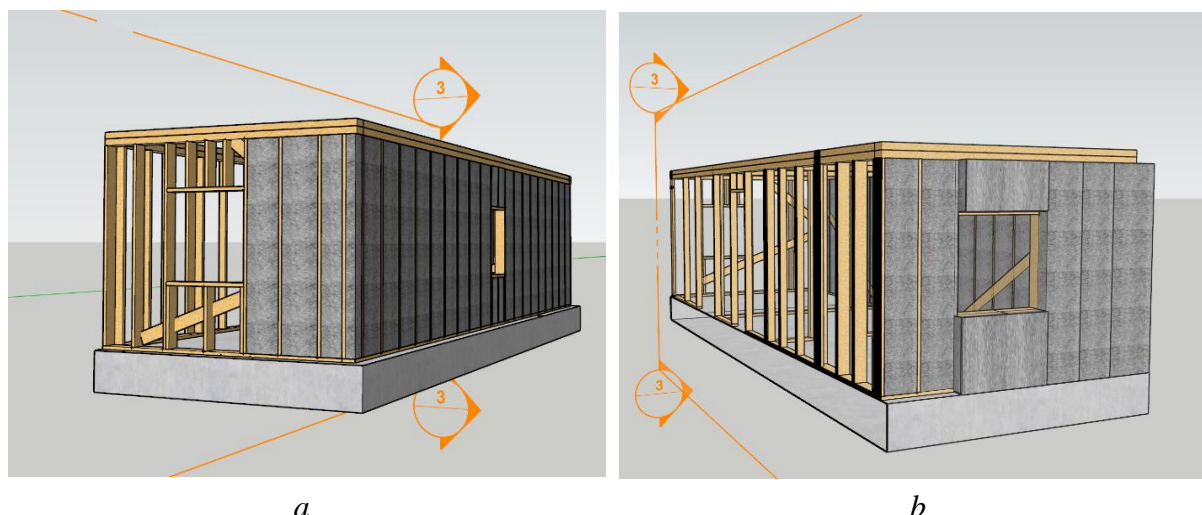
Fig. 6. 3D model of structural frame and its cross-section

Initially, by using single stud framing technique the space between vertical studs with some compaction is infilled with hempcrete as it shown in Fig. 7a and Fig.8a accordingly. As it was mentioned above, for this occasion OSB-made shuttering that repeats the contour of the studs was used.

Typically, the compaction force is manually provided while any mechanical influences including vibrations or ramming are strictly prohibited. In this case, the applied force for hand-tamping doesn't exceed of 5 MPa. After some hardenig of the mixture, the formwork is removed. For now, only 150 mm thick wall is assembled.



*Fig. 7. Typical hempcrete wall sections that were used in our case study:
a – single-stud; b – interior stud*



a *b*
 Fig. 8. 3D models of single-stud (a) and interior-stud (b) of hempcrete walls formation techniques

Interior-studs technique was utilized for a further wall formation (see Fig. 7, b and Fig. 8, b). For this occasion, the formwork is installed to create the contour of future exterior wall with the total thickness of 400 mm. Then in-situ hempcrete application technique is repeated.

After the all hempcrete walls have been formed its covered with the finishing layer of clay or lime/sand-based plaster without any polymerized membrane between hemp-lime and finishes (see Fig. 9, e). This finishing system provides the sufficient level of vapor permeability and breathability for a hempcrete wall while other finishes particularly gypsum plaster or so deteriorates dramatically the features mentioned above and can't be used in this context.

In Fig. 9, the external view of formed enclosures for the window opening (see Fig. 9, a), doorway (see Fig. 9, b) as well as external and internal corners formation of our studied case (see Fig. 9, c, d) are given.

It should be noted, that in our case, as an internal insulator the cottonwool plates of French brand Métisse with the thickness of 160 mm covered with the waterproofing membrane was used (see Fig. 9, f).



a

b

c



d

e

f

Fig. 9. External view of window opening (a), doorway (b), external and internal corners formation (c, d), first layer of external finishing (e), and internal insulation material (f)

Another crucial aspect to investigate is the thermal efficiency of hempcrete-based technique. It is well known that depending on the thickness of hempcrete (250...500 mm) its R-value (reduced thermal resistance) can vary significantly ranging from ~2 up to ~5 (m²·K/W).

In this case, the thermal calculations were carried out according to methodology extensively provided in [15], considering for a Climate Zone I that is inherent for Chernihiv region where standardized values of heat transfer resistance for enclosing structures of $R \geq 4$ (m²·K/W) [16].

The calculation models of examined enclosing structures are given in Fig. 10. They are made up of internal lime/sand finishing with the thickness of 20 mm with the subsequent hempcrete layer of 250 mm in thick (see Fig. 10, a) or 400 mm in thick (see Fig. 10, b) and internal finishing of lime/sand mixture with the thickness of 10 mm. For thermal performance calculations it has been also suggested that low density of 250 kg/m³ hempcrete mixture that is provided the highest level of thermal resistance about 0.071 W/m·K was utilized [12].



a

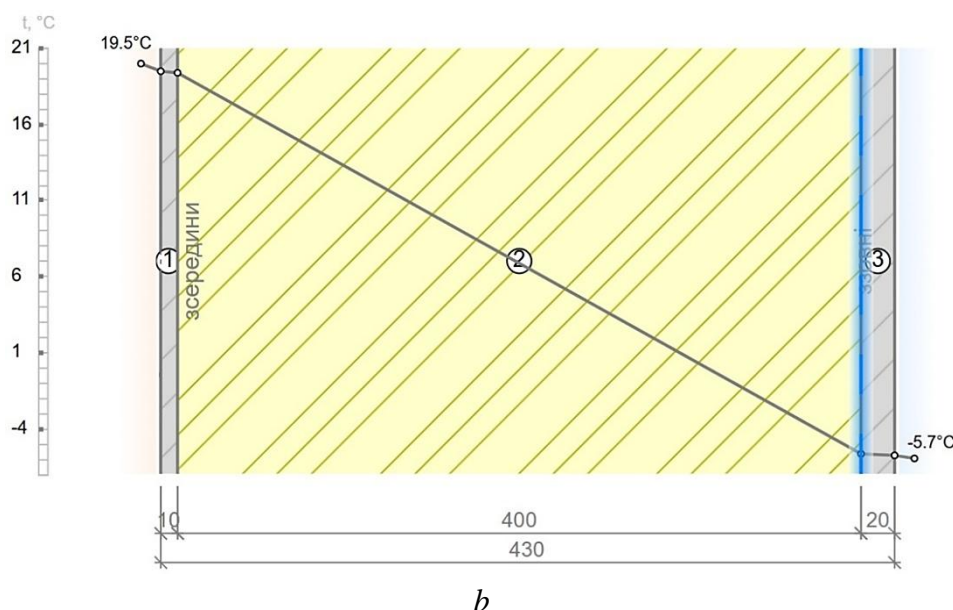


Fig. 10. Calculation models of examined enclosing structures: hempcrete layer with the thickness of 250 mm (a), and 400 mm (b) accordingly

The analysis of calculation results has revealed that for the wall structure with 250 mm of hempcrete infill the R-value does not exceed of $3.717 \text{ m}^2 \cdot \text{K}/\text{W}$ while for the enclosures with 400 mm of hempcrete provides R-value at a level of $5.601 \text{ m}^2 \cdot \text{K}/\text{W}$.

Thus, to ensure the regulatory requirements the hempcrete-made walls with the thickness of 400 mm or more is needed. It's worth to note that both structures provide good vapor permeability performances at a level of $1.143 \text{ m}^2 \cdot \text{h} \cdot \text{Pa}/\text{mg}$ and $1.679 \text{ m}^2 \cdot \text{h} \cdot \text{Pa}/\text{mg}$ for 250 mm and 400 mm hempcrete walls accordingly.

At the same time, the calculations have shown that in both cases the dew point is always presented inside the wall structure. The dew point temperature, which was calculated considering the air temperature is $20 \text{ }^\circ\text{C}$ and the relative humidity is 55% for both structures was about $9.92 \text{ }^\circ\text{C}$. Assuming that the hempcrete is the porous bio-composite that is hygroscopic and diffusion-opened can easily absorb this moisture into its pores and capillaries and over time safely release it inside-out without deterioration its mechanical properties.

Conclusions. It can be concluded that bio-composites as a constructional material, particularly the hempcrete, can be extremely advantageous specifically in terms of global sustainability, carbon footprint reduction, and resource saving increasing energy efficiency of residential households.

At the same time, in a view of low mechanical properties of hempcrete it can't be utilized as a load-bear structural material and typically applied along with the timber-made structural frame.

Regardless of hempcrete application technique, in order to ensure of high quality of hemp/lime mixture, sufficient compaction force, etc., the group of highly experienced workers is always required.

Based on a real practical case of single-family residential house construction the main techniques of cast-in-place hempcrete wall formation were examined. According to the thermal calculations it was established that single-stud hempcrete wall with the thickness of 150...250 mm doesn't meet the Ukrainian regulatory requirements at all. The R-value of such walls doesn't exceed of $2.5 - 3.717 \text{ m}^2 \cdot \text{K}/\text{W}$. In this context, to provide sufficient level of building's envelope thermal efficiency the interior-stud technique with the thickness of hempcrete walls of 400 mm and more is needed. Our calculations have shown that R-value of such walls reach up to $5.601 \text{ m}^2 \cdot \text{K}/\text{W}$ that provides a high level of energy efficiency and should be utilized in Chernihiv's Climate Zone.

References

1. Bolotov, M., Bolotov, H., Prybytko, I., & Korzachenko, M. (2024). Sustainable practices of concrete manufacturing. *Technical Sciences and Technologies*, (2(36)), 15–30. [https://doi.org/10.25140/2411-5363-2024-2\(36\)-15-30](https://doi.org/10.25140/2411-5363-2024-2(36)-15-30).
2. Abera, Y. A. (2024). Sustainable building materials: A comprehensive study on eco-friendly alternatives for construction. *Composites and Advanced Materials*, 33. <https://doi.org/10.1177/26349833241255957>.
3. Pochwała, S., Makiola, D., Anweiler, S., & Böhm, M. (2020). The heat conductivity properties of hemp–lime composite material used in single-family buildings. *Materials*, 13(4), 1011. <https://doi.org/10.3390/ma13041011>.
4. Linh, D., Salomone, R., & Nguyen, Q. T. (2023). Circular bio-based building materials: A literature review of case studies and sustainability assessment methods. *Building and Environment*, 244, 110774. <https://doi.org/10.1016/j.buildenv.2023.110774>.
5. *The European green deal*. (n.d.). European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.
6. Korjenic, A., Petránek, V., Zach, J., & Hroudová, J. (2011). Development and performance evaluation of natural thermal-insulation materials composed of renewable resources. *Energy and Buildings*, 43(9), 2518–2523. <https://doi.org/10.1016/j.enbuild.2011.06.012>.
7. Brzyski, P., Barnat-Hunek, D., Suchorab, Z., & Łagód, G. (2017). Composite materials based on hemp and flax for low-energy buildings. *Materials*, 10(5), 510. <https://doi.org/10.3390/ma10050510>.
8. Volf, M., Diviš, J., & Havlík, F. (2015). Thermal, moisture and biological behaviour of natural insulating materials. *Energy Procedia*, 78, 1599–1604. <https://doi.org/10.1016/j.egypro.2015.11.219>.
9. Maalouf, C., Ingrao, C., Scrucca, F., Moussa, T., Bourdot, A., Tricase, C., Presciutti, A., & Asdrubali, F. (2018). An energy and carbon footprint assessment upon the usage of hemp-lime concrete and recycled-PET façades for office facilities in France and Italy. *Journal of Cleaner Production*, 170, 1640–1653. <https://doi.org/10.1016/j.jclepro.2016.10.111>.
10. Kremensas, A., Kairytė, A., Vaitkus, S., Vėjelis, S., & Balčiūnas, G. (2019). Mechanical performance of biodegradable thermoplastic polymer-based biocomposite boards from hemp shivs and corn starch for the building industry. *Materials*, 12(6), 845. <https://doi.org/10.3390/ma12060845>.
11. Steyn, K., de Villiers, W., & Babafemi, A. J. (2025). A comprehensive review of hempcrete as a sustainable building material. *Innov. Infrastruct. Solut.* 10, 97. <https://doi.org/10.1007/s41062-025-01906-1>.
12. Tong, W., & Memari, A. M. (2025). State of the art review on hempcrete as a sustainable substitute for traditional construction materials for home building. *Buildings*, 15(12), 1988. <https://doi.org/10.3390/buildings15121988>.
13. *Spray-Applied Hempcrete System Gets New U.S. Distributor — HempBuild Magazine*. (n.d.). HempBuild Magazine. <https://www.hempbuildmag.com/home/espray-applied-hemp-usa>.
14. Hanieiev, T., Barbash M., Bolotov, G., & Bolotov, M. (2021). Design of life support systems for the housing complex. *Technical Sciences and Technologies*, (2(24)), 244–250. [https://doi.org/10.25140/2411-5363-2021-2\(24\)-244-250](https://doi.org/10.25140/2411-5363-2021-2(24)-244-250).
15. Jellen, A. C., & Memari, A. M. (2025). State-of-the-Art review of hempcrete for residential building construction. *Designs*, 9(2), 44. <https://doi.org/10.3390/designs9020044>.
16. Bolotov, M., & Prybytko, I. (2025). Thermal efficiency assessment of eco-oriented prefabricated modular buildings: case study. *Technical Sciences and Technologies*, (3(41)), 494–505. [https://doi.org/10.25140/2411-5363-2025-3\(41\)-494-505](https://doi.org/10.25140/2411-5363-2025-3(41)-494-505).
17. Ministry for Communities and Territories Development of Ukraine. (2022). *DBN V.2.6-31:2021: Thermal insulation and energy efficiency of buildings*. Kyiv, Ukraine.

Список використаних джерел

1. Bolotov, M., Bolotov, H., Prybytko, I., & Korzachenko, M. (2024). Sustainable practices of concrete manufacturing. *Technical Sciences and Technologies*, (2(36)), 15–30. [https://doi.org/10.25140/2411-5363-2024-2\(36\)-15-30](https://doi.org/10.25140/2411-5363-2024-2(36)-15-30).
2. Abera, Y. A. (2024). Sustainable building materials: A comprehensive study on eco-friendly alternatives for construction. *Composites and Advanced Materials*, 33. <https://doi.org/10.1177/26349833241255957>.
3. Pochwała, S., Makiola, D., Anweiler, S., & Böhm, M. (2020). The heat conductivity properties of hemp–lime composite material used in single-family buildings. *Materials*, 13(4), 1011. <https://doi.org/10.3390/ma13041011>.
4. Linh, D., Salomone, R., & Nguyen, Q. T. (2023). Circular bio-based building materials: A literature review of case studies and sustainability assessment methods. *Building and Environment*, 244, 110774. <https://doi.org/10.1016/j.buildenv.2023.110774>.
5. *The European green deal*. (n.d.). European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.
6. Korjenic, A., Petránek, V., Zach, J., & Hroudová, J. (2011). Development and performance evaluation of natural thermal-insulation materials composed of renewable resources. *Energy and Buildings*, 43(9), 2518–2523. <https://doi.org/10.1016/j.enbuild.2011.06.012>.
7. Brzyski, P., Barnat-Hunek, D., Suchorab, Z., & Łagód, G. (2017). Composite materials based on hemp and flax for low-energy buildings. *Materials*, 10(5), 510. <https://doi.org/10.3390/ma10050510>.
8. Volf, M., Diviš, J., & Havlík, F. (2015). Thermal, moisture and biological behaviour of natural insulating materials. *Energy Procedia*, 78, 1599–1604. <https://doi.org/10.1016/j.egypro.2015.11.219>.
9. Maalouf, C., Ingrao, C., Scrucca, F., Moussa, T., Bourdot, A., Tricase, C., Presciutti, A., & Asdrubali, F. (2018). An energy and carbon footprint assessment upon the usage of hemp-lime concrete and recycled-PET façades for office facilities in France and Italy. *Journal of Cleaner Production*, 170, 1640–1653. <https://doi.org/10.1016/j.jclepro.2016.10.111>.
10. Kremensas, A., Kairyte, A., Vaitkus, S., Vėjelis, S., & Balčiūnas, G. (2019). Mechanical performance of biodegradable thermoplastic polymer-based biocomposite boards from hemp shivs and corn starch for the building industry. *Materials*, 12(6), 845. <https://doi.org/10.3390/ma12060845>.
11. Steyn, K., de Villiers, W., & Babafemi, A.J. (2025). A comprehensive review of hempcrete as a sustainable building material. *Innov. Infrastruct. Solut.* 10, 97. <https://doi.org/10.1007/s41062-025-01906-1>.
12. Tong, W., & Memari, A. M. (2025). State of the art review on hempcrete as a sustainable substitute for traditional construction materials for home building. *Buildings*, 15(12), 1988. <https://doi.org/10.3390/buildings15121988>.
13. *Spray-Applied Hempcrete System Gets New U.S. Distributor — HempBuild Magazine*. (n.d.). HempBuild Magazine. <https://www.hempbuildmag.com/home/espray-applied-hemp-usa>.
14. Ганєєв, Т., Барбаш, М., Болотов, Г., & Болотов, М. (2021). Проектування систем життєзабезпечення житлового комплексу. *Технічні науки та технології*, (2(24)), 244–250. [https://doi.org/10.25140/2411-5363-2021-2\(24\)-244-250](https://doi.org/10.25140/2411-5363-2021-2(24)-244-250).
15. Jellen, A. C., & Memari, A. M. (2025). State-of-the-Art review of hempcrete for residential building construction. *Designs*, 9(2), 44. <https://doi.org/10.3390/designs9020044>.
16. Bolotov, M., & Prybytko, I. (2025). Thermal efficiency assesment of eco-oriented prefabricated modular buildings: case study. *Technical Sciences and Technologies*, (3 (41)), 494–505. [https://doi.org/10.25140/2411-5363-2025-3\(41\)-494-505](https://doi.org/10.25140/2411-5363-2025-3(41)-494-505).
17. Ministry for Communities and Territories Development of Ukraine. (2022). *DBN V.2.6-31:2021: Thermal insulation and energy efficiency of buildings*. Kyiv, Ukraine.

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ДОСЛІДЖЕННЯ ПРАКТИЧНОГО КЕЙСУ ТЕХНОЛОГІЇ БУДІВНИЦТВА ТА ЕНЕРГОЕФЕКТИВНОСТІ ЖИТЛОВОГО БУДИНКУ З БІОКОМПОЗИТНИХ МАТЕРІАЛІВ

У статті розглядається актуальна тема застосування біокомпозитних матеріалів на основі конопляного бетону як екологічно чистої, більш енергоефективної та ресурсозберігаючої альтернативи традиційним. Такі «зелені» будівельні практики дозволяють значно зменшити глобальні викиди CO₂, виснаження ресурсів, створюючи стимулююче середовище для її мешканців протягом усього життєвого циклу будівлі. Впровадження конопляного бетону в українську будівельну практику може бути надзвичайно корисним з погляду післявоєнної відбудови, коли попит на доступне житло різко зростає. Водночас існують деякі проблеми, що обмежують широке застосування конопляного бетону, пов'язані з відсутністю систематичного досвіду впровадження таких об'єктів на місцевому рівні, відсутністю інженерно-орієнтованих описів будівельних технологій, а також високим рівнем скептицизму споживачів щодо якості та довговічності будівель з конопляного бетону. Стаття має на меті систематично представити існуючі технології виробництва конопляного бетону, а також переваги та обмеження його застосування на основі результатів реального дослідження, та визначити перспективи його подальшого впровадження в малоповерховому будівництві в Україні в контексті сучасних європейських екологічних вимог. На основі реального практичного випадку одноквартирного житлового будинку було досліджено технології будівництва з конопляного вапна. Результати теплового розрахунку огорожувальних конструкцій будівлі показали, що технологія формування стін з конопляного бетону з однією стійкою товщиною 150...250 мм не відповідає українським нормативним вимогам. Коефіцієнт теплопередачі таких стін не перевищує 2,5...3,717 м²·К/Вт. У цьому контексті, для забезпечення достатнього рівня теплової ефективності огорожувальних конструкцій будівлі необхідна технологія внутрішнього каркаса з товщиною стін з конопляного бетону 400 мм і більше. Наші розрахунки показали, що коефіцієнт теплопередачі таких стін сягає 5,601 м²·К/Вт, що забезпечує високий рівень енергоефективності та доцільно використовувати в Чернігівській кліматичній зоні.

Ключові слова: сталий розвиток; екобудівництво; зелене будівництво; конопляний бетон; тепла ефективність; будівельні технології.

Рис.: 10. Бібл.: 17.