Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology № 121. 2023: 66-71
(Ann. WULS - SGGW, For. and Wood Technol. 121, 2023: 66-71)
Received: 08.12.22 / Accepted: 21.03.23 / Published: 29.03.23

The prospect of using retro timber in the furniture industry

SERGEI TROFIMOV[1], TATIANA NIKITINA[2], BARBARA PRAŁAT[3], JULIA LANGE[3], TOMASZ ROGOZIŃSKI[3]

[1] Department of Technology and Design of Wooden Articles, Faculty of Forest Engineering, Materials Science and Design, Belarusian State Technological University, Minsk, Sverdlova 13A, 220006 Minsk, Belarus
[2] Department Engineering Constructions, Architecture and Graphics, Higher School of Engineering, Northern Arctic Federal University, Severnaya Dvina Emb. 17, Arkhangelsk 163002, Russia
[3] Department of Furniture Design, Faculty of Wood Technology, Poznań University of Life Sciences, ul. Wojska Polskiego 38/42, 60-627 Poznań, Poland

Abstract: *The prospect of using retrowood in the furniture industry*. To avoid over-consumption of natural resources, the idea of recycling or extending the life of wood-based materials is often considered in recent times. Therefore, it seems appropriate to conduct research aimed at studying the mechanical properties of retrowood and determining the possibility of its application. As part of a scientific study, surveys of old wooden residential buildings (Никитина et al., 2017) of the Russian North with a service life of 60–100 years and mechanical tests of both retrowood and freshly cut wood were carried out. Comparison of indicators of physical and mechanical properties of old wood and new wood material used in the manufacture of furniture with normative indicators of properties was made. Based on the research results, an assessment was made of the possibility of reusing retrowood in the production of furniture and interior elements. Well-preserved vintage wood from old wooden houses being demolished is a potential resource-saving raw material for making furniture, which is confirmed by testing the properties of this material. Based on the research results, the possibility of designing and manufacturing furniture and interior elements from retro wood is considered.

Keywords: retrowood, furniture industry, resource-saving, environmental friendliness

INTRODUCTION

To avoid overconsumption of natural resources such as wood, the idea of recycling or reusing materials to extend their lifespan is being considered. People are becoming increasingly aware of the consequences of environmental pollution and the overuse of natural resources. Currently, measures are being developed and carried out to reduce the harmful effects of humans on the environment, the irrational use of natural resources and the management of generated waste. To cope with the current situation, reduce the impact on nature and completely replace the linear economy of "take-do-waste", the circular economy is increasingly being introduced. The potential benefits of this type of economy include increased security of raw materials, the desire for innovation in many industries, and the creation of new jobs, which increases corporate competitiveness and the desire for innovation (Bourguignon, 2016). The idea of recycling or reusing materials to extend their lifespan comes up quite often.

Wood, as a natural material, has great potential to extend its lifespan. When properly designed to consider the time after the end of a product's life, such as recycling, it can remain in circulation much longer, reducing waste and carbon dioxide emissions into the atmosphere. Timber from older buildings that are outside of its intended service life can be reused or recycled.

Research related to the mechanical properties of retrowood is quite complex due to the characteristics of the material. The unknown origin, the original mechanical properties, their variability, and the difficulty of obtaining samples are problems for research. Therefore, the comparison of individual results of scientific works is a difficult task. Several different approaches and aspects have been explored. Most studies agree that flexural and compressive

strengths are not significantly reduced. Since not many studies have been conducted that have concluded on every aspect of this issue, therefore, no unambiguous conclusions can be drawn (Cavalli et al., 2016).

Almost every part of the wooden house can be reused or upcycled if it's kept in good condition. Logs, boards, roof trusses, or rafter framings. For example, Höllentalangerhütte, a cottage located in the northern Alps was examined in terms of end-of-life, reuse, and recycling methods. The cottage is composed of several rooms built over the course of about 70 years. The material, wooden logs were used oldest over 120 years ago. Results show that the wooden construction is still in good condition and could be reused. Parts that are moldered or damaged in any way, cannot be reused, because of safety issues. Used paint or coats may contain harmful substances, so the wood used in construction or walls coated with paint must be examined in more detail. Wood obtained from the Alpine cottage can be reused, because of the simple design and usage of good wood (Hafner et al., 2014).

A large supply of retrowood is in forested regions, where wood was the main building material. Such regions are Belarus and Russia ("Ретро Доска — Покупаем старую амбарную доску по всей России," n.d.),("Амбарная доска в Беларуси — Сравнить цены и купить на Flagma.by," n.d.),("Сделано," n.d.). Due to climatic and weather conditions, wooden houses in Eastern Europe and in the North of Russia are generally in good condition. The wood has not significantly degraded, retaining its strength properties. A significant number of buildings can be found in small villages and towns abandoned due to the migration of the population to cities (Figure 1.).

As a rule, houses were built from seasonally harvested wood, natural drying, and long-term aging. At the same time, the material did not deform, and the stabilization of properties continued during operation.

Retrowood in modern times is sometimes an antique. It can be characterized by changes in the structure and color, woodworm moves, cracks, surface irregularities from sawing or manual processing, which give the material its uniqueness and attractiveness. It is no coincidence that wood is sometimes subjected to artificial aging.

Environmentally friendly and beautiful furniture can be made by reusing wooden structures (boards, beams, etc.) of old objects. Enhance the unique look of retro wood with modern industrial design tools such as brushing. Time, destroying the wood, emphasizes its beauty and the raw surface of the old material can tell the attentive observer about its distant past. By using wood from the demolition of old houses, we increase its service life, otherwise, it would be burned or thrown away. Therefore, it seems appropriate to study the mechanical properties of retrowood and assess the possibility of its reuse.

MATERIALS

Objects were identified and samples were taken from the structural elements of wooden buildings operated in the conditions of the Arctic zone of the Russian North with exceeding the standard service life (more than 50 years), (Figure 2). A standard sampling procedure was used for laboratory studies of wooden structural elements. Standard samples were made, the shape of which depended on the type of test (Figure 3). Since the retrowood changed its color and structure, it was impossible to accurately identify its species. The wood species was determined by density (larch, pine, and spruce). Samples were taken from elements of external and internal walls, piles, bed timber, floor beams, and roof structures. At least 3–5 samples were taken from each construct. Samples were taken from lightly loaded and weakly stressed sections of structural elements (Никитина, 2021).

Samples were tested on a Shimadzu 50kN testing machine at the Department of Wood Science and Woodworking Technology of the Northern (Arctic) Federal University named after M.V. Lomonosov (Arkhangelsk, Russia) NArFU. Wood samples were tested for compression

along, across the fibers, and at an angle to the fibers, for static bending, chipping, and stretching. A total of 966 samples were tested, including larch 485, pine 256, and spruce 225. The summary results of determining the physical and mechanical properties of wood are shown in Table 1.

The process of inspecting abandoned housing constructions in the villages of the Arkhangelsk region and preparing samples of retrowood is illustrated in Figures 1 and 2.

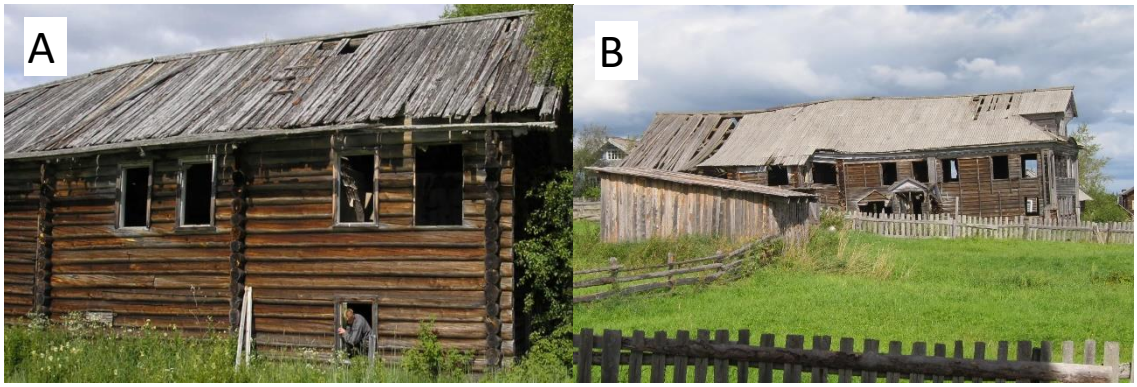

Figure 1. Abandoned peasant houses built in the 19th century in the process of inspection (during inventory) A-Arkhangelsk, st. Severodvinskaya, 5, building 1, 1931, B- p. Kamenka. House of Grooms, st. Tortseva, 20, 1928

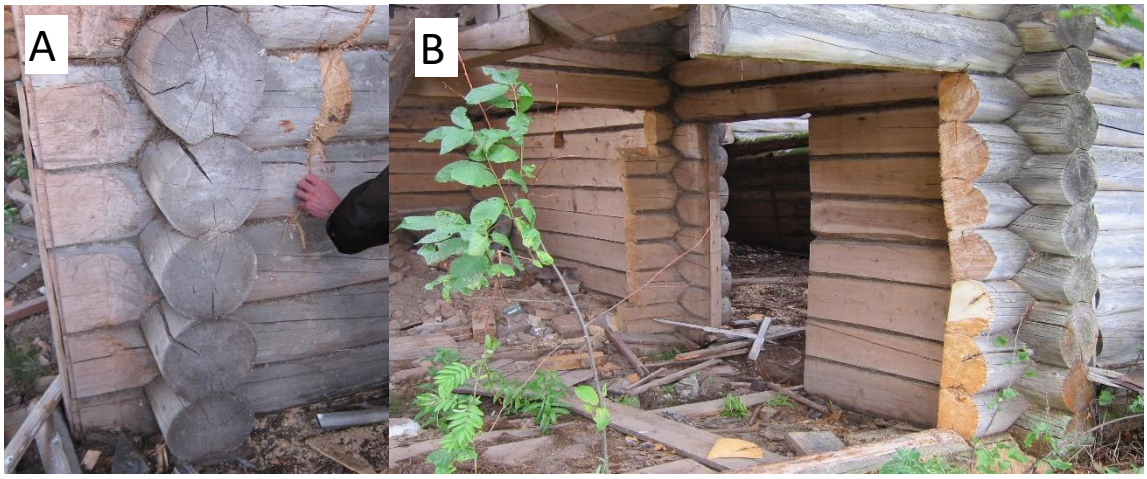

Figure 2. The process of collecting samples of retro wood, A- Kamenka, per. Baseiny, 4, 1929; B- Kamenka. House of Grooms, st. Tortseva, 20, 1928

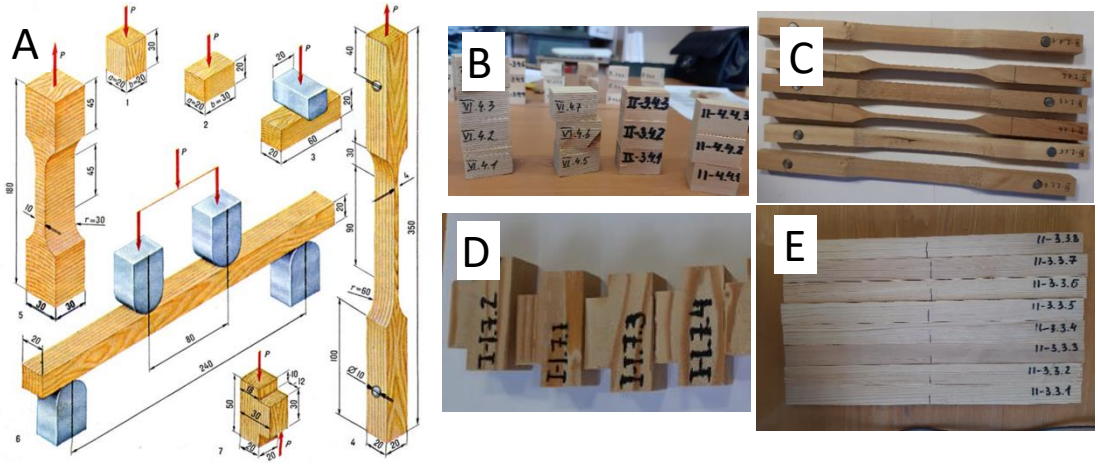

Figure 3. Samples for testing, A- General scheme of sampling, B - compression test samples, C- tensile test samples, D- shear test samples, E-bending test samples.

RESULTS

The results of mechanical tests are presented in Table 1. The samples showed that they have a significant margin of safety. Sometimes the margin of safety of wood exceeds the normalized values. Wood has a different quality depending on the time, species, origin, and conditions of use. The bending strength of the samples allows them to be classified as materials used in furniture production. Larch wood taken from the stair beam of an old house had the highest calculated bending strength. Other tests should be considered, such as impact strength, a very sensitive test that is important in the furniture industry.

Table 1. Estimated resistance of wood (Strength resource of wood) [8]

An object	Estimated resistance of wood, MPa								
	For compression					Tensile along the fibers	Static bending	Shearing along fibers	
	Along the fibers	Across the fibers		Angle 45°					
		Tangentially	Radially	20x20	30x20			Radial plane	Tangent plane
Calculated resistance, MPa	24	2,7	2,7	6,33	6,33	10,5	24	2,4	2,4
LARCH									
Arkhangelsk, st. Severodvinskaya, 5, building 1, 1931									
Stair beam	17,61	1,55	2,1	1,17	1,07	5,84	13,46	2,32	2,32
p. Kamenka. House of Grooms, st. Tortseva, 20, 1928									
Stair beam	16,14	2,22	1,22	2,01	1,37	14,27	12,14	2,21	2,98
Kamenka, per. Baseiny, 4, 1929									
Stair beam	12,66	2,64	1,02	1,13	0,69	11,91	7,99	2,42	-
Arkhangelsk, Obvodny Canal Ave., 26, 1956									
Stair beam	14,19	1,6	-	-	-	-	9,00	-	-
PINE									
Arkhangelsk, st. Severodvinskaya, 5, building 1, 1931									
Sling. leg	15,25	1,54	1,47	0,57	1,07	11,68	7,24	1,86	1,34
p. Kamenka, per. Baseiny, 4, 1929									
Sling. leg	15,36	2,23	1,06	0,95	1,39	8,79	12	2,66	2,25
SPRUCE									
Kamenka. House of Grooms, st. Tortseva, 20, 1928									
Outer wall	10,14	1,83	0,69	-	-	12,68	5,75	2,14	-
Kamenka, per. Baseiny, 4, 1929									
Outer wall	10,83	1,06	1,03	0,69	0,84	6,61	7,14	2,35	1,91

The strength resource of retrowood has been established, depending on environmental conditions, service life, and the presence of constructive protection from atmospheric influences. These factors affect the state of preservation of wooden elements of residential buildings and cultural heritage sites and the level of degradation and destruction of the material of structural elements. For example, the indicators of the actual modulus of elasticity of coniferous retrowood of the European North of Russia (larch, pine, and spruce) have some margin: for larch – 10 ... 66%, for pine – 15 ... 35%, for spruce – 6 ... 14%, except for outdoor

walls of buildings, where the decrease in the modulus of elasticity of the first kind, amounted to 11.4% (Сопилов and Никитина, 2018),(Никитина, 2021).

Table 2 shows the ratios of calculated compressive strengths characterizing the anisotropy of freshly cut and retro larch wood. Retrowood is characterized by a decrease in the degree of anisotropy (2,97 ... 12,4%).

Table 2. Comparison of calculated resistances during compression of larch wood (Nikitina, 2020)

Type of wood and indicators	R_α / R_r	R_α / R_t	R_t / R_r
Freshly cut wood, MPa	12,43	6,79	1,83
Retrowood, MPa	10,89	6,6	1,65
Discrepancy of indicators, %	-12,4	-2,97	-9,84

Note: Calculated compressive strength of larch wood (MPa): R_a – along the fibers; R_r and R_t – across the fibers in the radial and tangential directions.

As a result of the research, the technical indicators of coniferous retrowood obtained from elements of wooden structures of buildings in the European North of Russia decommissioned for 50–100 years, were determined. The design characteristics of wood were obtained considering the anisotropic properties and operating conditions (Никитина, 2021),(Сопилов and Никитина, 2018),(Никитина et al., 2020). The possibility of reusing this material for engineering purposes has been proven.

When harvesting retrowood and its inspection, if necessary, phytosanitary disinfection of the material can be carried out, for example, considering the requirements of the international standard ISPM 15.

CONCLUSION

Retrowood from well-preserved wooden houses is a potential raw material that can be used in the furniture industry. This is confirmed by tests to determine the mechanical properties of the resulting wood material. Since there are currently no regulatory limits on the service life of products made from this wood, their determination should be based on a study of wood over time, considering the characteristics of deformation and operating conditions. Other tests must also be considered, such as impact strength, which is sometimes of decisive importance in the furniture sector. This wood offers many opportunities in the field of furniture as a recycled raw material, which fits perfectly into the principles of the circular economy, which has recently been widely promoted by the European Union. An additional advantage of retro wood is its aesthetic value, which provides the unique character of furniture made from this material.

The research results can be accepted for use in the development of regulatory and technical documents in the field of design and engineering work. The use of this material complies with the requirements of "green" standards. Physical and mechanical indicators, the aesthetic appeal of retrowood, and its positive effect on the conservation of forest natural resources allow us to conclude that it is advisable to use it in various areas, including furniture production and interior design.

REFERENCES

1. Bourguignon, D., 2016. Closing the loop. New circular economy package.
2. Cavalli, A., Cibecchini, D., Togni, M., Sousa, H.S., 2016. A review on the mechanical properties of aged wood and salvaged timber. Construction and Building Materials 114, 681–687. https://doi.org/10.1016/j.conbuildmat.2016.04.001
3. Hafner, A., Ott, S., Winter, S., 2014. Recycling and End-of-Life Scenarios for Timber Structures, in: Aicher, S., Reinhardt, H.-W., Garrecht, H. (Eds.), Materials and Joints in

Timber Structures, RILEM Bookseries. Springer Netherlands, Dordrecht, pp. 89–98. https://doi.org/10.1007/978-94-007-7811-5_8
4. Амбарная доска в Беларуси — Сравнить цены и купить на Flagma.by [WWW Document], n.d. . Flagma.by. URL https://flagma.by/products/q=%D0%B0%D0%BC%D0%B1%D0%B0%D1%80%D0%BD%D0%B0%D1%8F+%D0%B4%D0%BE%D1%81%D0%BA%D0%B0/ (accessed 6.7.23).
5. Никитина, Т.А., 2021. Технический ресурс ретродревесины хвойных пород в элементах деревянных конструкций (автореф. дис. канд. техн. наук спец). САФУ, Архангельск.
6. Никитина, Т.А., Морозов, А.М., Филиппов, В.В., 2017. Обследование Деревянных Домов В Посёлке Каменка Мезенского Района Архангельской Области. pp. 168–182.
7. Никитина, Т.А., Шестаков, Ю.Д., Лабудин, Б.В., Куницкая, О.А., Тихонов, Е.А., Калита, А.Ю., 2020. Прочностной Ресурс Древесины Лиственницы Беломорского Севера При Сжатии В Главных И Диагональных Осях Анизотропии. Деревообрабатывающая Промышленность.
8. Ретро Доска — Покупаем старую амбарную доску по всей России [WWW Document], n.d. URL https://retrodoska.ru/ (accessed 6.7.23).
9. Сделано [WWW Document], n.d. URL https://artkamin.com/proekt (accessed 6.7.23).
10. Сопилов, В.В., Никитина, Т.А., 2018. Прочностной Ресурс Элементов Конструкций Деревянных Зданий За Пределами Нормативных Сроков Эксплуатации. Инженерные Кадры - Будущее Инновационной Экономики России.

Streszczenie: *Perspektywa wykorzystania drewna retro w meblarstwie*. Aby uniknąć nadmiernej konsumpcji zasobów naturalnych, w ostatnim czasie często rozważa się ideę recyklingu lub przedłużenia życia materiałów drewnopochodnych. Dlatego celowe wydaje się prowadzenie badań mających na celu poznanie właściwości mechanicznych retrodrewna i określenie możliwości jego zastosowania. W ramach badań naukowych przeprowadzono badania starych drewnianych budynków mieszkalnych [1] północnej Rosji o żywotności 60–100 lat oraz badania mechaniczne zarówno retrodrewna, jak i świeżo ściętego drewna. Dokonano porównania wskaźników właściwości fizycznych i mechanicznych starego drewna i nowego materiału drzewnego stosowanego do produkcji mebli z normatywnymi wskaźnikami właściwości. Na podstawie wyników badań dokonano oceny możliwości ponownego wykorzystania retrodrewna w produkcji mebli i elementów wyposażenia wnętrz. Dobrze zachowane stare drewno pochodzące z rozbiórki starych drewnianych domów jest potencjalnie zasobooszczędnym surowcem do produkcji mebli, co potwierdzają badania właściwości tego materiału. Na podstawie wyników badań rozważana jest możliwość projektowania i wytwarzania mebli oraz elementów wyposażenia wnętrz z drewna retro.

Corresponding author:
Tomasz Rogoziński,
ul. Wojska Polskiego 38/42,
60-627, Poznań, Poland
email: Tomasz.rogozinski@up.poznan.pl
phone:+48618487483