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## **NATURAL BUILDING AS AN ENVIRONMENT FRIENDLY SOLUTION**

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### ***Abstract***

The study is supposed to start a series of research on the role of natural building as an environment friendly solution. It includes the results of a survey which was carried out to define the level of university students' ecological awareness of benefits and development prospects of this technology in Poland. Young people were surveyed to find out their knowledge of the solutions based on natural resources available in the environment. It has been established whether positive attitude of students toward the natural environment can find reflection in their approval of eco-building and subsequently, willingness to invest money in construction of such buildings in the future. An important question has been addressed, that is, whether people are interested in houses made of clay, straw or wood and whether they consider them as cheap, durable, modern and esthetic architectural forms.

**Key-words:** natural building, environment protection, ecology building, academic youth

### **INTRODUCTION**

The issues involved in environment protection and sustainable development and ecological building are being more and more frequently addressed in scientific papers of many research centers and in economic facilities as familiarity with these problems is useful in making decisions to invest in construction

of such ecological buildings both in the country and abroad (Runkiewicz 2016). The foci of the research and development are: green building design technology, building energy-saving technology and equipment, renewable energy devices and development of integration technology, exquisite construction and green building construction technology and equipment, energy-saving building materials and green building materials, and provision of energy-saving technical standards (Zhang et al. 2018). According to Kietliński (2015), building is one of the areas which have a significant influence on the natural environment. The author adds that the solutions which are being sought need to provide people with comfort and be environment friendly. However, the progress in protection of the natural environment associated with development of construction and architecture depends on ecological awareness of current and future generations (Kietliński 2015). Due to the fact that the design, construction, operation and maintenance of buildings normally requires enormous amounts of energy, water and raw materials causing air and water pollution (Radwan et al. 2015) such materials as: clay, straw, wood or hemp are being increasingly used, though according to Kapłańska (2017), people associate application of such materials with past times, in many countries people come back to the methods used by their ancestors. It can be expected that in Poland this trend, though in its infancy, is likely to gain more and more popularity (Kapłańska 2017).

The goal of this study is to answer the question whether college students are aware that the natural building technology uses safe and environment friendly materials as well as to assess young peoples' knowledge of sustainable practices in this field. At the same time, financial issues connected with construction of such buildings and their lifetimes have been discussed. In view of the natural environment degradation new architectural solutions are becoming more and more important. However, it needs to be emphasized that the interest in 'natural houses' is still in the initial phase and is dictated by the fashion for ecological buildings.

## **MATERIALS AND METHODS**

At the turn of 2018-2019 a group of 250 respondents were surveyed by means of an anonymous diagnostic poll method. The survey was carried out on a group of Bydgoszcz university students from 7 voivodeships (Kujawsko-Pomorskie 87.1%, Pomorskie 6.1%, Wielkopolskie 4%, Mazowieckie 1.2%, Warmińsko-mazurskie 0.8%, Dolnośląskie 0.4%, Lubelskie 0.4%). Respondents aged 20-24 were prevailing (73.5%), whereas those aged 19 accounted for 21% of respondents. They represented 6 study majors: Civil Engineering (46%), Environmental Engineering (16%), Renewable Energy Sources (15.6%), Architecture (10%),

Geodesy and Cartography (7.2%) and Interior Architecture (5.2%). Town residents accounted for 56% vs. 44 % (mostly men 50.7% vs 49.3%).

The respondents were asked 29 questions, including 21 of closed character. Analyses of the survey results allowed to assess the ecological awareness of the young respondents on the subject of:

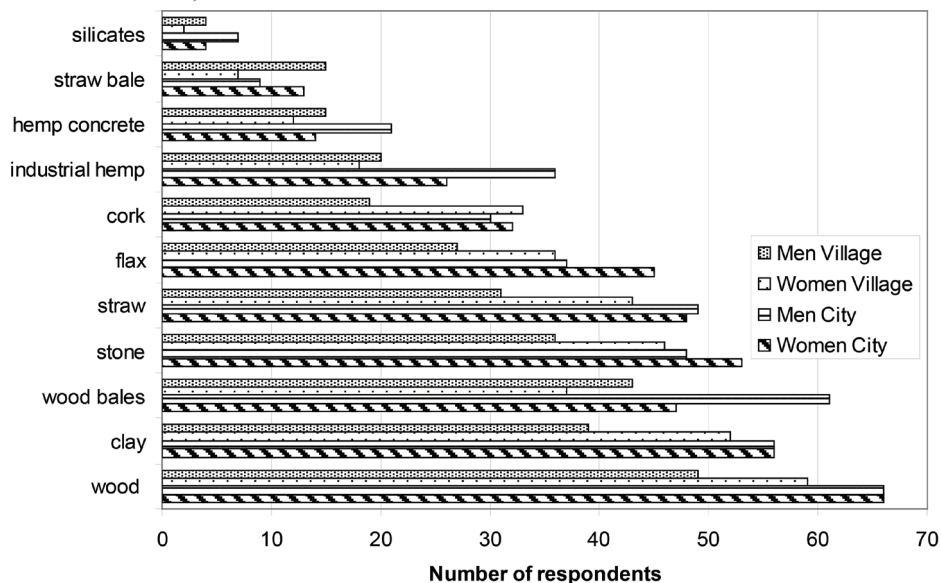
1. popularity of natural buildings in Poland, their lifecycle, energy efficiency and comfort;
2. barriers and development prospects of this technology in Poland;
3. causes and benefits of such investments for the investors and for the environment;
4. economic benefits from the operation phase of a house built from natural materials.

It was explored (using Pearson correlation coefficients  $r$ ) to what degree the variables (including: investment costs, popularization of the investment, life time, benefit for the natural environment) affecting the overall planning of investments in natural building. The survey is of pilot character and will provide the basis for more detailed research on natural building, that is, analysis of potential technological applications (study case) and practical solutions, used by individual investors.

## **RESULTS AND DISCUSSION**

From all (250) respondents, 209 (that is 83.6%), tried to provide definition of natural buildings. Most frequently described it as based on technology using natural resources (72.2%) and called it ecological building (10.5%), environment friendly (8.6%), or energy efficient (2.4%). A group of 1.9% of respondents described it as using nontoxic and chemically unprocessed materials. The remaining respondents (4.4%) called it sustainable building which defies traditional technologies or uses raw materials. These descriptions are consistent with the opinion of specialists who are involved in construction of such buildings from low processed, recyclable and locally available materials to minimize the impact of the construction process on the environment ([www.slomianydom.eu/budownictwo-naturalne](http://www.slomianydom.eu/budownictwo-naturalne)). The materials used in this branch which were indicated by students included: wood (96%), clay (81.2%), wooden logs (75.2%), stone (73.2%), straw (68.4%), cotton (58%), cork (45.6%), industrial hemp (40%), hemp concrete (24.8%), straw bale (17.6%) and silicates (6.8%). According to the criterion of the respondents' place of residence (village or town) and their sex, it can be observed that all the before mentioned materials were indicated more frequently by town residents and women (fig. 1). Materials of natural origin can be used as materials for heat insulation, e.g. straw, sheep wool or cellulose, but they can also be used as construction or finishing materials, e.g. plywood, materials from

tree fibers with an external gypsum plate or clay plaster with straw (Wasilewska, Pietruszka 2017).



Source: own study

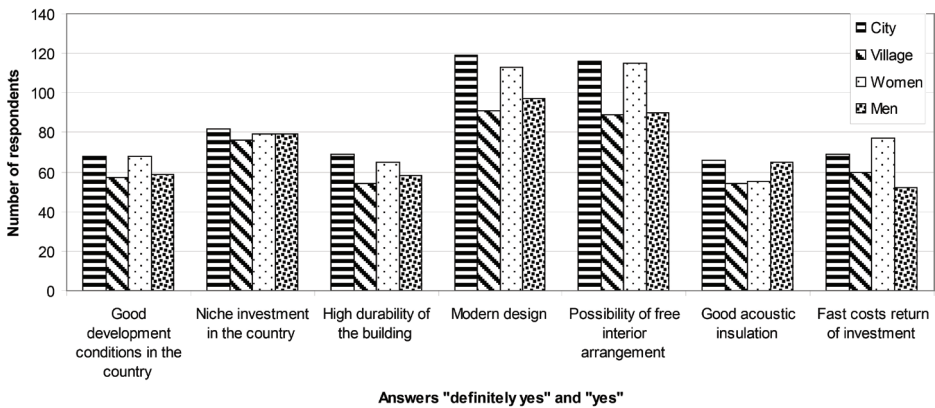
**Figure 1.** Materials most commonly used in natural building (indicated by women and men, residents of town and rural areas).

Despite growing interest in nonconventional construction materials both on the home and foreign market (hemp with addition of lime binder, straw bales or not burned clay) (Golański 2012), the respondents observed that in Poland natural building is still of niche character. Such an opinion was expressed by 158 students whose answer was ‘definitely yes’ (12%) and ‘yes’ (51.2%). Only 21 persons were of a different opinion (8.4%), whereas 28.4% (76) of the respondents had no opinion on this subject. No close relation between the small group of market investors interested in this kind of building and the lack of its popularity in the country was found (-0.288). In turn, correlation significance at the level of 0.942 confirmed that the niche character of such an investment is associated with a belief that its life cycle is short and the construction costs are higher (as compared to a conventional building) (0.654). Young people think that the prices of natural houses range from 151 to 300 thousand PLN (55.3%) and over 300 thousand PLN (14.5%), and the life cycle of a natural building is 50-60 (34.4%) or 30-40 years (25.9%). Usually, the price of a natural house depends on the design. If the design is simple and compact and it has a standard finish, the price of its building shell is about 2500 PLN/m<sup>2</sup> including fixtures and fittings and

the roof cover. In fact, there is no limit. A natural house, especially one which is built from straw, can be cheap if self-constructed. Like most of new designed buildings, the natural ones are designed for a period of 50 years. It may seem to be a short time but it also refers to brick houses. The oldest house constructed with the use of straw is now 115 years old and is situated in France. As specialists emphasize, there is no reason to think that natural houses are shorter lived than the conventional ones ([sломianydom.eu/faq/](http://sломianydom.eu/faq/)). Students' opinions on this subject were divided since as many as 49.8% (123) of them assessed resistance of this type of buildings to various external and internal factors as high (43.3% – 'yes', 6.5% – 'definitely yes'), and 30.7% (76) said 'I know nothing about their resistance' (mainly women – 52.6%, town residents – 60%). In turn, 19.5% (48) of young people doubted in structural reliability of such houses (17% – 'no' and 2.5% – 'definitely no'), though Brzozowska-Backiel (2014), observes that if clay or straw structures are to be resistant and durable they need to be properly protected from dampness, especially from ground water and precipitation. Otherwise, clay can be easily washed out from the surface of walls. Wet surface is susceptible to frost and can easily be damaged. Continuous dampness of straw can in turn lead to biological corrosion.

According to the respondents, the conditions for development of such buildings in Poland are quite good (42.8%) and very good (8%). Women (54.3%) and town residents (53.3%) were more optimistic in this respect. Unfortunately, even though the conditions for development of ecological buildings are good, there are not enough qualified specialists in this field. Moreover, there is poor knowledge of such construction technologies. A significant correlation was reported for both the first and the second case, respectively at the levels of 0.861 and 0.692. According to the surveyed persons, promotion should take the form of appropriately prepared advertising campaigns (including those sponsored by the government) (23.8%), documentary movies broadcast on TV (12.8%), the Internet (11%), loans on preferable terms and financial support (7.3%), fliers, brochures, press adverts (6.1%), promotion in social media in order to provide information about living conditions in such houses and health benefits (11%). The respondents also focus attention to the aspect of wellbeing and they list 5 most important reasons for which people might choose to live in a natural house. These are: widely understood environment protection – 83.6%, energy efficiency – 56.4%, nontoxicity of materials – 54%, health issues – 42.4%, fashion – 36.4%. Although they put health on the fourth position, the materials applied in natural buildings (clay or straw), are appreciated due to the natural and healthy microclimate they provide – dampness control, heat energy cumulation, binding of harmful substances and antistatic reaction to dust (Brzozowska-Backiel 2014). The analyses of the survey results have proved that those were mostly men (67% vs 33%)-town residents who indicated a trend as the reason to turn to natural building (60.6% vs 39.4%). In turn, women tended to indicate measurable bene-

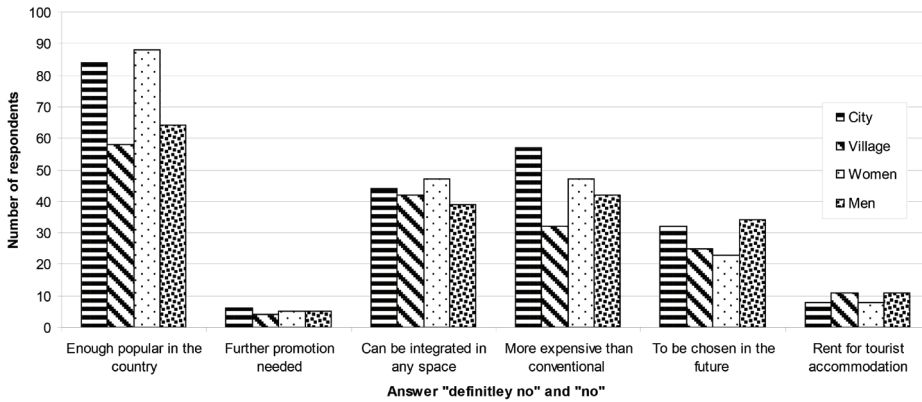
fits for the environment and health. In students' view, natural buildings can look modern (60.1% 'yes' and 25.2% 'definitely yes'), and they offer vast possibilities of interior arrangement (60% 'yes' 22.6% 'definitely yes'). However, they were not sure whether these houses are provided with good acoustic insulation (41.6% 'yes' and 7.3% 'definitely yes' vs 31.9% 'I do not know', 16.8% 'no' and 2.4% 'definitely no'), which is a very important factor determining the quality of living conditions in a house made of clay or straw. Although they would choose such a place to spend there a vacation (53% 'yes', 27.1% 'definitely yes'), they were skeptical about living in such a house on a permanent basis. (32% 'yes' and 7.6% 'definitely yes' vs 37.6% 'I do not know', 17.6% 'no' and 5.2% 'definitely no'). They cannot be convinced that these houses can integrate into urban or rural landscape as 34.4% of respondents are aware of the problem and 12.4% are not able to state whether a natural house will harmonize with the environment. 30% of the respondents (that is 12% of the whole group), whose friends already had ecological houses, revealed less concern about it (mainly clay, straw and wooden bale were used as construction materials). A small group of the surveyed students (4.3%) declared that this is the responsibility of Polish architects to promote natural building technologies and show the new approach to the environment. Few respondents knew organizations or associations of specialists, enthusiasts, executors or designers involved in construction that poses no threat to human health or the natural environment (four choose just one possibility persons indicated: Cohabitat, Polish Association for Natural Building – OSBN, Eco-building, Eko-Kopuła).



Source: own study

**Figure 2.** Comparison of respondents' selected opinions (positive) on natural building (according to division into the place of residence and gender of the respondents).

Basing on selected positive and negative opinions of the respondents about natural building (fig.2 and 3), it can be observed that the results indicate approval and interest in this kind of building.



Source: own study

**Figure 3** Comparison of the respondents' selected opinions on natural building (according to division into respondents' place of residence and gender).

Students think that small popularity of this technology in Poland is an obstacle to development of natural building (22.3% of all the respondents mainly women – 73%), which additionally is confirmed by the fact that as many as 30% of all the respondents learnt about natural building from the survey. Economic aspect was also indicated as a barrier (construction cost disproportionately high in relation to low salaries) (18.7%, mostly men – 64.5%), mentality of Poles (attachment to traditional construction methods, fear of new things, reluctance to stand out from others) (16.9%), unfavorable climatic conditions (12%), unfavorable policy of the government (7.2%), insufficient number of companies and specialists in this field (5.4%), difficulties in acquisition of materials (3.6%) and preference for lobbed longer lasting structures, (3%). Some respondents emphasized architectural limits, low biodegradability of materials used in construction of these houses, their poor insulations, small durability of the material, as well as ubiquitous consumerism reflected in a lack of ecological attitudes, more oriented to contemporary extravagant trends (10.8%). Young people see a chance for natural building mainly in the environmental factor (17.8%). In the opinion of the respondents, degradation of the natural environment will force people to turn to old building traditions. At the same time, they observe that high quality clay, straw or wood are easily available on the domestic market (16.9%). In their opinion the biggest potential lies in the society which tends to ‘return to nature’ a healthy lifestyle (9.7%). The weather conditions in Poland which are favorable

for development of ecological building (8.8%) are thought to be an advantage of this kind of technology as well as availability of cheap materials which enables to reduce the overall cost of a house construction (8.8%).

There are also respondents who think that the considered technology can find its development chance in research on cheaper and more friendly solutions (7.9%), education (7%) or introduction of a beneficial system of national and EU financing to support these investments (6.2%). Moreover, students think that hope lies not only in young people, who are more interested in this technology than the older generations, but also natural independence of Polish people in decision making. Also, the economic growth of the country and its good territorial conditions as well as potential possibilities to educate skilled construction workers were indicated by the respondents. Attention was also focused on a house, an object which is supposed to be biodegradable, consistent with technical requirements, equipped with renewable energy sources, adjusted to the diversified Polish landscape (16.9% answers). According to the respondents, the 3 main arguments which are in favor of a clay, straw or wooden house are: environment friendliness (83.6 %), nontoxicity (54%) of materials and energy efficiency that a house can be provided with (56.4%). The decision whether the respondents will build an ecological house, primarily depends on the financial means (0.833) and access to construction specialists on the market (0.611). It was observed that such a decision would largely depend on durability of the building (0.920), and costs return during its use (0.925). Positive attitude of young people toward the environment protection appears to be significant (0.577). External appearance of the building does not play a significant role in these plans (0.375) as compared to interior arrangement (0.452). Ecological awareness of their close friends would not have a significant influence on the decision whether to invest in an ecological house. It was 'definitely low' (23.5%) and 'low' (45.7%). The surveyed students acquired knowledge mainly from the Internet (34.4%), lectures (20.8%), TV (8%) and branch newspapers (6.8%). However, it is the positive attitude of young people toward the natural environment that can decide whether to build a house from natural materials (0.577) or not. As many as 74.7% of the students declared that by being supportive of the natural environment they could contribute to its successful protection. The fact that young people did have had awareness of environmental threats has been confirmed by their ability to define the quality of the air in the place they live (76%). They described it as being good (53.6%) or bad and very bad (38.5%). Only 7.9% acknowledged that the quality of air raises no objections. Many students admitted that one way or another some of their activities had a negative impact on the environment (42.3%), however, there was a group of students who were involved in actions for environment protection (34.8%). This refers to participation in an international campaign 'Cleaning the Earth' (54.8%) and 'The Earth Day' (14.5%) – an action to promote ecological attitudes in the society. Students also took part in 'Day Without



a Car', collection of electro waste, planting trees, forest protection, distribution of fliers with ecological information, happenings on behalf of ecological organizations World Wide Fund for Nature (WWF) and Greenpeace. Some of them are also involved in supporting the above mentioned organizations, e.g. they support financially reconstruction of bee population (30.7% of such people were reported). The respondents were asked about environmental issues because, without a doubt, well established ecological attitudes and behaviors not only determine purchase decisions of the consumers but also (Radzymińska et al, 2015), makes them understand that the possibilities which are provided by nature are worth taking advantage of and are beneficial both for the environment and for themselves. Innovative, ecological solutions to be used in natural building will considerably contribute to reduction of emissions, and wastes as well as noise, vibrations and radiation. (Kamieniarz 2016). Students know that their attitude will have a significant impact on the natural environment. Their primary concern was connected with waste segregation (28.3%), keeping clean the environment (12.8%), economical water consumption (8.5%), use of public transport (7.8%), more efficient energy use (6.4%), use of refill bags (3.5%). Scatter of answers in this respect was significant. The respondents declared that they would try to find employment in the branch of renewable energy sources or invest in them. They also declared willingness to promote ecological ideas among friends and family members such as: removal of dangerous asbestos, organization of home composters, buying high quality fuel or investing in ecological energy sources, more conscious purchase of common products, appropriate waste disposal, participation in ecological actions for protection of fauna and flora, signing different kinds of petitions in favor of the environment, openness to scientific achievements in this field (total 32.7%). The respondents, when asked about what they had done for the environment, indicated trash segregation separation (45.6%) and keeping clean the surrounding areas (parks, forests) (9.2%). Moreover, the surveyed students said that they had been saving water and energy on a regular basis. They were involved in tree planting, use rain water for domestic purposes, invest in renewable energy sources (photovoltaic panels and sun ray collectors), remove asbestos from the roofs, reduce purchase of products from nondegradable materials, put filters on chimneys, use natural cleaning supplies and ecological bags and packages, invest in modern energy efficient equipment (45.2% answers). The above observations prove that students are aware of ecological threats and are involved in environment protection. These positive attitudes are likely to find reflection in willingness to deepen the knowledge of natural building and maybe decision to join the construction process of houses from low-processed materials. The results of the carried-out survey allow to establish that young people are aware that this is their responsibility to set the ecological trends and lifestyle. They are far more open to changes and innovation and they show more initiative than older generations, and though for many respondents it was the survey which

motivated them to explore the subject as they had not been much familiar with issues connected with ecology and natural environment before – they found it necessary to live in a sustainable, healthy environment.

## CONCLUSIONS

The following conclusions have been formulated on the basis of the survey results:

1. According to the respondents, natural building, an environment friendly solution, has good development prospects in Poland. However, it needs constant promotion through education and exchange of knowledge and experiences among specialists.
2. Women indicated benefits from ecological investments more often than men, they emphasized a long lifecycle of an ecological building, many possibilities of its interior design and exterior arrangement.
3. In the future, the attitude of young people toward protection of the natural environment can turn into interest in investment in ecological houses, taking into consideration a full life cycle of buildings.
4. In near future the importance of houses built with the use of sustainable technologies is likely to increase along with an increase in ecological awareness of societies, progressing consumption and depletion of natural resources.

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## REFERENCES

- Brzozowska-Backiel, B. (2014). *Clay and straw building. Initial assessment of selected aspects of durability*. Ecological Engineering 4: 108-2016.
- Golański, M. (2012). *Energy efficiency with the use of nonconventional construction materials*. Zero energy building. Przegląd Budowlany 12: 68-74.
- Kamieniarz, M. (2016). *Inovative and ecological clay building*. Magazine of Architecture. Civil and Environmental Engineering, JCEEA, XXXIII, 63 (3/16): 151-158.
- Kapłańska, A. (2017). *Return of natural building*. Architecture. Krakowski Rynek Nieruchomości 14: 14-15.

Kietliński, W. (2015). *Ecological building and energy efficient building of the future*. Sustainable Development. Przegląd Budowlany 2: 36-41.

Radwan, MR., Kashyout ALHB., ELshimy, HG., Ashour, SF. (2015). *Green building as concept of sustainability. Sustainable strategy to design Office building*.

Radzymińska, M., Jakubowska, D., Mozolewski, W. (2015). *Ecological behaviors and attitudes toward the natural environment*. Handel Wewnętrzny 2(355): 346-356.

Runkiewicz, L. (2016). *Issues of environment protection and 'Ecology and Architecture'*. Rynek budowlany. Przegląd Budowlany 2: 6-10.

Wasilewska, A. W., Pietruszka, L.B. (2017). *Natural materials in eco-building*. Ecology vs. Architecture. Przegląd Budowlany 10: 50-53.

Zhang, Y., Kang, J., Jin, H. (2018). *A Review of Green Building Development in China from the Perspective of Energy Saving*. [in:] Energies 11 (2): 334.

<https://slomianydom.eu/budownictwo-naturalne/> – accessed: 11.03.2019

<https://slomianydom.eu/faq/> – accessed: 11.03.2019

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