Survey on green roofs in Poland

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Abstract. The aim of this paper is to present the results of a survey on green roofs among potential real estate developers and users, concerning knowledge about, awareness of the benefits of, and interest in green roofs. The survey sample consisted of 151 persons – potential owner-builders from Poland. This is not a large number, but it is significant. The research sample was purposive and statistically insignificant, and the study was an initial part of a larger project. Greenery in urban settings positively affects human quality of life and health and contact with nature improves well-being and reduces stress. Roofs covered with greenery are also a sign of growing environmental awareness. In Poland, green roofs are usually a feature of public and commercial buildings. The low popularity of this solution in single-family housing has its source in potential owner-builders being unaware of the benefits of the roofs' application, funding opportunities, and benefits in the form of a greater amount of biologically active surfaces. Currently, the technology of covering roofs with greenery is highly developed, and there are many experienced contractors who operate on the Polish market. However, there is a deficiency in knowledge about green roofs among real estate developers and prospective owner-builders, which constitutes a demand barrier. Many people are anxious about using a green roof out of fear of high construction costs and necessary greenery maintenance. This is due to misinformation, as it is possible to use an extensive, low-maintenance roof type. In the case of an intensive roof, the maintenance largely resembles that of a traditional domestic garden. The costs of creating a roof garden are higher than in the case of traditional roofing materials, but a smaller plot could be bought as a result, as a greater amount of biologically active surfaces can be obtained to meet zoning regulations. In Poland, there are currently no legal regulations that obligate or incentivise the use of green roofs. The popularity of this solution is growing, which gives hope for making cities greener. In an era of progressing climate change, building additional green spaces, including those on roofs, is a crucial remedy for the severe consequences of unsustainable urbanisation.

1 Introduction

Research problems should be studied using suitable methods. When survey studies are concerned, it is human opinion and preferences that are studied. External factors were found

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to affect survey respondents and relations between them [1]. Surveys were used as preliminary research stages in the area of construction [2-4], and served as data sources in decision-making support [5, 6].

Surveys, despite being typically applied in the social sciences and less often in the technical sciences, can facilitate problem-solving in many construction-specific areas. This paper continues a subject previously presented in 2020 and 2022 WMCAUS conferences [7].

Nematchoua et al. [8] used a survey to investigate user satisfaction with thermal conditions in education and housing buildings in Madagascar during the rain and dry seasons, performing their study on a sample of 1000. The respondents reported greater comfort in housing buildings. Nering et al. [9] complemented their investigation of acoustic comfort in Poland. Comfort of use inside buildings with internal thermal insulation applied was investigated in [10, 11].

Fedorczak-Cisak et al. [12] had a group of experts use a questionnaire to evaluate relationships between benefits to society and the benefits of preserving a building's cultural heritage. It later served to support a multi-criteria analysis of selecting a new use for a heritage building adaptive reuse project [13]. Expert surveys can also be used to assess how measurable and hard-to-measure parameters affect each other and dependencies between them [14].

Construction service providers and clients and their needs and preferences can also be studied using surveys. Officials, contractors and consulting firm representatives were asked about the needs of Ghanese small and medium- sized construction businesses by Asante et al. [15]. Decision factors that influence building material purchase choice were investigated by Ivanova and Smetanina [16], while building rehabilitation needs were gauged by Nowogońska [17].

A series of studies explored partnering cooperation in construction [18,19], as well as methods that can be used to control them [20], while its impact on project time-cost parameters was investigated in [21], while in [22] an original algorithm was proposed to facilitate subcontractor selection, potentially for use by general contractors. Information flow in construction projects was also investigated multiple times [23-25].

Sustainable construction continues to be a major theme in academic research, and thermal retrofitting is a part of this area [26]. Preferences concerning technical solutions for sustainability-focused projects were gauged in [27], while the urban layout of a housing estate was assessed in [28] – both studies relied on expert opinion surveys.

Surveys have also been used to investigate and study green building and attitudes towards it. Green roof design solutions were analysed in Greece on a sample of 800 local residents, finding them to be in high demand [29]. Darko and Chan [30] interviewed 43 experts on green building in Ghana to identify potentially successful promotion strategies. Obstacles in the wider adoption of green building were investigated in [31], finding 20 significant barriers in a Ghanese context.

This study presents the results of a survey on green roofs that was conducted in Poland. The survey gauged knowledge and awareness of the potential benefits that can be gained in green roofs and interest in them. The survey was performed online in 2021 and had a sample size of 151 owner-builders, who formed a purposive sample and thus the sample size can be considered statistically significant. This survey is a part of a larger research project and will form its initial steps.

2 Results of the survey

65.6% of respondents have already encountered the term "green roof," but 57% have not yet seen a facility with a green roof. The majority of respondents (92.7%) believe that green roofs can be used as usable space. Plants that respondents believe can be placed on a green roof are

mainly grasses and mosses (94%), followed by flower meadows (52.3%) and shrubs (45%) and trees (21.9%). The vast majority of respondents rated their knowledge of the functions and benefits of green roofs as low. Potential investors may show less interest in green roofs due to incomplete knowledge of the visual and environmental advantages of this solution. Low awareness among potential users, of the useful aspects of green roofs, affects the less frequent application of this solution in practice.

Another task was to assess the importance of the various benefits of green roofs:

- aesthetic appearance,
- possibility to use as usable space,
- improvement of microclimate,
- restoration of ecological balance,
- energy efficiency,
- better thermal and acoustic insulation of the building,
- retention of rainwater, relieving pressure on the sewage system.

The most important benefit for the respondents (87%) turned out to be the improvement of the microclimate, which indicates the growing awareness of people on the subject of ecology, and this may suggest the increasing use of ecological solutions in construction. On the other hand, when asked to rate how demanding, on a five-point scale, the maintenance and care of green roofs is, only 2% think it is "not very demanding," and 6% think it is "somewhat demanding." The majority of respondents show great concern, as many as 63.5% marked the answers "demanding" or "very demanding."

When asked about their preference for the purpose of a green roof, the majority of respondents (68.9%) indicated a structural element with additional aesthetic value and additional usable space. The fewest respondents (11.3%) indicated only a structural and aesthetic aspect, and 19.9% indicated the option of a roof with a utilitarian character. From the respondents' answers to the question of what type of building they think the use of vegetation on the roof fits into, it appears that for the majority the green roof fits into all types of buildings. It is noteworthy that there was a high indication (91.4%) for public buildings and for apartment blocks (75.5%). The lowest indication by respondents was for a single-family house (45.7%). These results coincide with the real state, as green roofs are most often used on buildings such as galleries, hotels or apartment blocks, single-family houses with green roofing are rare. The utility functions of a green roof are more desirable in cities, that is, where there is a lack of green space and contact with nature. In single-family houses, which are often accompanied by a garden, the utility function of a green roof seems to lose its value and it is treated only as a structural element. This confirms the advantages of a green roof in terms of improving the urban climate.

34.4% of respondents do not plan to make a construction investment in the near future, while 17.2% have already made such an investment. Among respondents who own an apartment or a house, when asked whether they would be interested in a green roof in the event that they needed to renovate their current roof, the answers steered toward less interest. Respondents who are just planning a construction project plan to do so within a year (8.6%), up to five years (19.9%) or more than five years (19.9%). The majority plan to build a single-family house. Interest in choosing a green roof among those who plan to invest is also low. Most people are planning to build a single-family house, and green roofing for such a structure is generally less popular among potential buyers.

Respondents, were asked to justify what influences such a decision, Responses were as follows:

- I don't like it (6.3%),
- in my opinion it is expensive to implement (51.6%),
- in my opinion it is expensive to maintain (31.3%),
- in my opinion, maintenance is time-consuming (57.8%),

- in my opinion, with the passage of time, plants become unsightly (26.6%),
- in my opinion, it is easy to make mistakes in execution (50%),
- in my opinion, there may be a problem with leakage (48.4%),
- other (6.3%).

The biggest barriers to interest in a green roof are time-consuming maintenance (57.8%), the assumption of high execution costs (51.6%), ease of making mistakes in execution (50%), and fear of leakage problems (48.4%). Of lesser concern were maintenance costs (31.3%) and the impact of time on the aesthetic appearance of the plants (26.6%). Only 4 people indicated that they did not like this solution. There were several "other" responses. One person has too little knowledge to be interested in this covering. Two people, due to the planned construction of a single-family house, do not want such a roof. One person wrote about the sharp angle of the roof, which may indeed cause difficulties in implementation. One person wants a usable attic, and believes that in such a case there is no possibility of using a green roof. One person assumes that the use of such a covering requires changes in the building design, which may raise problems in meeting other design considerations.

Half of the respondents were residents of cities with more than 100,000 residents, while those living in rural areas accounted for 33.1% of respondents. Among residents of cities with more than 100,000 residents, 23.1% indicated "very high interest" in green roofs. Urban residents show more interest in green roofs compared to those living in rural areas. More people living in the city were also familiar with the term green roof and had seen such an implementation compared to rural residents. Respondents were also asked whether it is possible to get funding to implement a green roof. The votes were split, with 50.3% saying no. It turns out that many people do not know about the possibility of obtaining subsidies to implement a green roof, this is a barrier before applying a green roof.

3 Conclusions

The research method should be well chosen, adequately to the research problem. In the case of survey studies, it is people who are the object of study and their opinions are analysed. Surveys are a preliminary stage for further research and analysis in construction and are a source of data used to support decision-making.

Greenery in urban settings positively affects human quality of life and health and contact with nature improves well-being and reduces stress. Roofs covered with greenery are also a sign of growing environmental awareness. In Poland, green roofs are usually a feature of public and commercial buildings. The low popularity of this solution in single-family housing has its source in potential owner-builders being unaware of the benefits of the roofs' application, funding opportunities, and benefits in the form of a greater amount of biologically active surfaces.

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