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ARCHITECTURAL, MATERIAL AND CONSTRUCTIVE SOLUTIONS IN DWELLING HOUSES OF SELECTED ORGANIC FARMS IN LUBLIN VOIVODESHIP

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ABSTRACT

The paper presents investigations performed in selected organic farms in the west part of the Lublin Voivodeship. The subject of the investigations were dwelling houses in these farms. Their architectural, material and constructive solutions have been analyzed and conclusions concerning connections between organic farm itself and the dwelling house situated in it have been drawn.

Key words: organic farm, dwelling house, material and constructive solutions

INTRODUCTION

The technology of building materials allows application of increasingly economic and ecological materials as well as whole construction systems being used to erect building objects which consume much lower quantity of energy both in the stage of construction and exploitation. The ecological systems should fulfill a set of requirements during the whole period of their existence (Mikoś, 2000). The ecological material and constructive solutions should be applied in all possible types of building investment. The issue of ecological materials is known in the literature. It was the subject of the investigations of Racięcki (1950), Pawlikowski (1955), Stachowicz, Gintowt and Wojdyło-Wróbel (1993), Stachowicz, Kram and Rawski (1993), Kelm (1996), Janiak (1999a, 1999b), Mikoś (2000), Żurakowska (2006), Kupiec-Hyła (2008, 2009), Kamieniarz (2009), Sawicki (2009), Brzyski (2016).

Ecological building construction become increasingly common in today's world, however they are not yet a standard. This work focuses on places where the ecology is of the most important meaning, that is the organic farms. It seems that in these very places the ecology should reach the highest level, starting from buildings and ending to products. It is due to the fact that the application of ecological solutions much more identifies these places with a function that they fulfill – the function of ecological food production. In the light of the above, it appears appropriate to answer the question: what have been dwelling houses in the organic farms built of?

MATERIAL AND METHODS

The work was aimed on checking mutual connections between the ecological way of farming (certified organic farm) and the building substance existing there

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(dwelling houses in these farms). The scope of the investigations encompassed an identification of material and constructive solutions of the houses. The research method consisted in a field inspection along with description of the houses and collection of photographic data, interview with buildings' owners concerning the dwelling substance (year of erection, dates of modernization, information on material solutions in external walls, foundations and other items impossible to acquire during the field inspection).

RESULTS

The investigations were performed in the west part of the Lublin Voivodeship[1]. Two of the investigated farms are located in the Łuków County, 12 in the Radzyń Podlaski County. It was examined 14 dwelling houses in 14 farms.

Building 1

The dwelling house was erected in the 1980s. It is located on a farmstead plot. It is a two-storey house without basement, with non-usable attic, it has the dimensions 7.0 × 7.0 m and the height 7.5 m. The house has been constructed on ferroconcrete continuous footings and concrete foundation walls. The walls of the ground and first floors are one-layered, plastered, built of ceramic hollow bricks with the thickness 25 cm. The cover is a closely-ribbed Teriva® ceiling. The roof has been built as a rafter construction, it is a hip roof covered with a flat metal sheet. The internal stairs is a stringer construction made of wood (Fig. 1).

Building 2

The house was erected in the 1990's. It is a two-storey one-family house, with basement and usable attic, it has dimensions 12.0 × 9.0 m and the height 11 m. The house has been constructed on ferroconcrete continuous footings, the cellar has concrete walls. The walls of the overground storeys are three-layered: the internal layer is made of ceramic hollow bricks with the thickness 19 cm, then there is the Styrofoam™ (15 cm) and cavity brick (12 cm). The ceiling is ceramic and closely-ribbed (its type has not been recognized). The roof has been constructed with purlins and collar ties, covered with a corrugated sheet; the attic has been insulated with a mineral wool and finished with gypsum and cardboard plates. The internal stairs have been made of ferroconcrete, supported on the wall and beam (Fig. 1).

Building 3

The house was erected in 1989. It is a two-storey house, with full basement and usable attic, it has dimensions 8.0 × 6.0 m and the height 9 m. The house has been constructed on ferroconcrete continuous footings and the basement concrete walls. The walls of the overground storeys are three-layered: the carrying layer is made of ceramic hollow bricks with the thickness 19 cm, the thermal insulating layer – the Styrofoam™ (10 cm) and the facing – a lime-sand brick (12 cm). The ceiling is ceramic, closely-ribbed. The roof is the collar beam construction, covered with a steel corrugated sheet. The attic has been insulated with a mineral wool and finished with gypsum and cardboard plates. The stairs have been made of ferroconcrete, supported on beams (Fig. 1).

Building 4

The house was erected in 1999 as two-storey without basement, with usable attic, it has the dimensions 8.0 × 9.0 m and the height 11 m. The building is supported on ferroconcrete continuous footings and foundation concrete walls. The walls of the ground and first floor have been made of concrete hollow bricks (24 cm) outside and cavity brick (12 cm) inside, without insulation. The ceiling is closely-ribbed, made of the Teriva® hollow bricks. The roof framing is a rafter construction, covered with a steel corrugated sheet. The internal stairs have been made of ferroconcrete, supported on the wall and a beam (Fig. 1).

Building 5

The dwelling house was erected in 1975 as a one-storey house without basement, with non-usable attic, it has the dimensions 9.0 × 5.0 m and the height 4 m. It has been constructed on foundation walls made of crushed stone bonded with cement mortar. The walls of the overground storey have been made of

[1] The second participant of the investigations was Paweł Dziób, MSc.

Fig. 1. Dwelling houses in the farms 1–7. After the number of the farm, a name of its village is placed (own elaboration)

(starting from the outside): wooden balks connected with a tongue-and-groove joint (19 cm), cement and chip boards (10 cm) and plank board (1.5 cm). The ceiling is naked, made of wood. The house has the gable roof with framings supported on the ceiling beams. The roof is covered with roofing paper. There are no stairs in the building, the attic is accessible with use of a ladder (Fig. 1).

Building 6

The dwelling house was erected in 1990 as a one--storey house with basement, with non-usable attic, it has the dimensions 11.0 × 6.0 m and the height 4.5 m. It has been constructed on ferroconcrete continuous footings and concrete foundation walls. The walls of the ground floor have one layer made of concrete hollow bricks (25 cm). The ceiling is a beam ribbed construction, made of wood. The house presumably has the gable roof, it is covered with cement-asbestos boards. There are no stairs in the building (Fig. 1).

Building 7

The house was erected in 1996 as a two-storey, with full basement and usable attic, it has dimensions 10.5 × 9.0 m and the height 12.5 m. The foundations are ferroconcrete continuous footings on which the basement concrete walls have been constructed. The walls of the overground storeys have been made as a cavity wall with non-ventilated 2 cm thick air cavity between the aerated concrete carrying layer (24 cm) and ceramic brick covering layer (12 cm). Then, the Styrofoam™ insulation has been made (10 cm). The ceiling is monolithic, reinforced in two directions, made of ferroconcrete. The roof is the collar beam construction, covered with a steel flat sheet. The stairs have been made of ferroconcrete, supported on the wall and beams (Fig. 1).

Building 8

The dwelling house was erected in 1995 as a two-storey house without basement, without attic, it has the dimensions 9.0 × 7.5 m and the height 7.5 m. It has been constructed on ferroconcrete continuous footings with foundation concrete walls. The walls of the overground storey have been made as a cavity wall with the aerated concrete layer (24 cm) non-ventilated air cavity (2 cm) and ceramic hollow brick layer (19 cm). The walls are not additionally insulated. The ceiling is closely-ribbed, ceramic. The house has the "envelope" roof covered with roof tile sheets. The vertical communication in the house is provided by ferroconcrete stairs supported on beams (Fig. 2).

Building 9

The house was erected in 1986 as two-storey, with basement, with non-usable attic, it has the dimensions 7.5 × 9.0 m and the height 8 m. The building has been erected on ferroconcrete continuous footings and basement concrete walls. The overground floors have been built as a cavity wall having a concrete block layer (24 cm), a non-ventilated air cavity (2 cm) and a ceramic brick layer (19 cm). The ceiling has been made of ferroconcrete slabs (10 cm). The house has the "envelope" roof covered with cement-asbestos boards. The internal stairs have been made of ferroconcrete, supported on beams (Fig. 2).

Building 10

The dwelling house was erected in 1976 as a one--storey house without basement, with non-usable attic, it has the dimensions 8.0 × 6.0 m and the height 6 m. It has been constructed on foundation walls made of crushed stone bonded with cement mortar. The walls of the ground floor have been made of wooden balks connected with a tongue-and-groove joint, a reed mat insulation and plank board as the elevation. The ceiling is naked, made of wood, the ceiling beams support the rafter-beam roof covered with roofing paper. There are no stairs in the building (Fig. 2).

Building 11

The dwelling house was erected in 1982 as a one-storey house with partial basement, with non-usable attic, it has the dimensions 8.5 × 9.0 m and the height 8 m. It has been constructed on ferroconcrete continuous footings with concrete foundation walls. The walls of the ground and first floors have been built as a cavity wall with an aerated concrete layer (24 cm) and a ceramic hollow brick layer (19 cm) with a non-ventilated air cavity (5 cm) between them. The ceiling has been made of ferroconcrete slabs (10 cm). The house has the "envelope" roof covered with steel sheet. The stairs have been made of ferroconcrete, supported on beams (Fig. 2).

Fig. 2. Dwelling houses in the farms 8–14. After the number of the farm, a name of its village is placed (own elaboration)

Building 12

The dwelling house was erected in 1999 as a one-storey house with partial basement, with usable attic, it has the dimensions 11.0 × 8.0 m and the height 9 m. It has been constructed on ferroconcrete continuous footings with concrete basement walls. The walls of the ground and first floors have been built as three-layered: of ceramic hollow bricks (19 cm), the Styrofoam™ (15 cm) and cavity brick (12 cm). The ceiling is closely-ribbed, ceramic. The roof has been constructed with purlins and collar ties, covered with roof tile sheets. The stairs are a steel construction filled with wood (Fig. 2).

Building 13

The house was erected in 2003 as one-storey, with basement, with usable attic, it has the dimensions 7.5 × 9.0 m and the height 8 m. The foundation has been constructed as ferroconcrete continuous footings and basement concrete walls. The overground floors have been built as a cavity wall having a cellular concrete block layer (24 cm), ceramic brick layer (12 cm) and an air cavity (2 cm) between them. The ceiling is closely-ribbed, ceramic. The roof is the collar beam construction, covered with roof tile sheets. The internal stairs are self-carrying, made of wood (Fig. 2).

Building 14

The house was erected in 1996 as one-storey, with basement, without attic, it has the dimensions 8.0 × 8.0 m and the height 5.5 m. It has been constructed on ferroconcrete continuous footings and foundation concrete walls. The ground floor walls have been built as three-layered: of ceramic hollow bricks (19 cm), the Styrofoam™ (15 cm) and cavity brick (12 cm). The ceiling is wooden. The roof is the "envelope" construction, covered with roof tile sheets. The internal stairs have been made of ferroconcrete (Fig. 2).

DISCUSSION

Dwelling plot

The plots where the houses have been built are farmstead plots – other buildings (inventory, farming, storing) are also located there.

Year of construction

From the investigated buildings, the oldest one was constructed 46 years ago, the newest – in 2003. The most houses, i.e. ca. half of the all investigated, was built in 1990s, whereas 14% – in 1970s. There are 7% of new houses, erected after the year 2000.

Floor space area

The investigated houses have various floor space area. For the biggest house, it is ca. 108 m^2, for the smallest one – ca. 45 m^2. The average floor space area is ca. 69 m^2.

Construction of buildings – external walls

The two houses are made of wood, the remaining ones are masonry constructions – two of them have one-layered walls, five have cavity walls with air cavity, one has two-layered walls and the rest – three-layered walls with various materials for facing (ceramic brick – 3, lime-sand brick – 1).

Foundations

Twelve buildings have been constructed on ferroconcrete continuous footings. Two buildings have foundation walls made of crushed stone bonded with mortar, without distinct continuous footing.

Insulation of the buildings

Three buildings do not have any thermal insulation layer. The remaining ones have insulation. As an insulation layer, it was applied the air cavity (4), the Styrofoam™ (5), the cement and chip boards and the reed mate. The thicknesses of the air cavity oscillate between 2 and 5 cm, whereas the Styrofoam™ – between 10 and 15 cm.

Roof covering

The most common roof covering in the investigated objects are the roof tile sheets which have been applied in four houses. The flat metal sheet has been applied in three houses, the corrugated sheet – in three as well, the roof paper in two. Two buildings still have the cement-asbestos boards, so-called eternit, on their roofs.

Windows

The wooden windows have been applied in eight buildings, the PVC windows in five of them, whereas in one building – the aluminum windows.

Renovations

The most often performed renovation was the window exchange (6) which in all cases, except of one, consisted in replacing the wooden windows by the PVC ones. Then it was the exchange of the roof covering (2) as some of the buildings originally had the cement-asbestos covering. Solar collectors as renewable energy sources have been applied to heat water in five buildings. Rain water is acquired for watering plants in four cases.

Architecture

With respect of the architectural conception, the investigated buildings fit into the period in which they were erected. They are one-storey wooden buildings (the oldest objects), the buildings constructed in the 1980s and having a low ground floor, in theory not intended for habitation, grand two-storey buildings from the 1990s as well as buildings erected in recent years and having a smaller, sustainable shape. A usability program of the buildings also reflects the construction period. The majority of the buildings fulfills the function which is typical for a country house in a farmstead, i.e. ensures multigenerationality of the house users, though in various standard (number of rooms, vertical communication routes, "clean" and "dirty" entries, summer kitchen, eye contact with a farmyard).

RECAPITULATION

In the beginning of the 21st century, first publications appeared concerning buildings in organic farms (Dąbkowski, 2002, 2003, 2004). In the later years, the publications appeared concerning dwelling houses in organic farms (Dąbkowski & Matuszewicz, 2010; Dąbkowski & Pędzich, 2015, Dąbkowski, Olszewska & Chalecki, 2018). Results of the investigations on the dwelling houses showed a neglectable influence of the ecological way of farming on the dwelling houses.

The direct investigations performed in the selected organic farms in the Lublin Voivodeship and presented in this paper show that, in fact, there is no connection, even slightly related to the ecological building construction, between the organic way of farming and the dwelling houses in such farms. The materials which are nowadays considered as ecological can be found in some of the investigated houses but it results merely from the construction period of the building when the application of e.g. wood was usual due to the accessibility of such raw material and its low cost. It does not any connection to the ecological vision of buildings.

None of the buildings has been insulated in such a way which would ensure that the building fulfills the current standards concerning heat transfer coefficient. Simplified calculations of the heat transfer coefficient for external walls – according to the standard PN-EN ISO 6946 (Polski Komitet Normalizacyjny [PKN], 1999), adequate for the age of most buildings – give the result between 0.3 and 0.92 $W \cdot m^{-2} \cdot K^{-1}$ what makes it necessary to increase the energy consumption for heating each building. Although in the majority of the buildings it has been applied the thermal insulation in form of the Styrofoam™, its layers are too thin to ensure an appropriate thermal protection of the building. The cement-asbestos boards still are on the two buildings. In the one of the houses, the renewable energy sources are applied.

If considering features of regional architecture, in most cases, the country houses in the investigated farms do not use the heritage of past generations (with the exception of two wooden houses).

If one has undertaken a trial of ecological farming in his/her farm, it is important to perform renovations and modernizations of any kind with ecological awareness in mind.

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ROZWIĄZANIA ARCHITEKTONICZNE I MATERIAŁOWO-KONSTRUKCYJNE W BUDYNKACH MIESZKALNYCH WYBRANYCH GOSPODARSTW EKOLOGICZNYCH WOJEWÓDZTWA LUBELSKIEGO

STRESZCZENIE

W artykule omówiono badania przeprowadzone w wybranych gospodarstwach ekologicznych zachodniej Lubelszczyzny. Obiektem badań były budynki mieszkalne zlokalizowane w gospodarstwach. Przeanalizowano ich rozwiązania materiałowo-konstrukcyjne i architektoniczne oraz przedstawiono wnioski dotyczące powiązania gospodarstwa ekologicznego z domem znajdującym się w tym gospodarstwie.

Słowa kluczowe: gospodarstwo ekologiczne, dom, rozwiązania materiałowo-konstrukcyjne