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THE TECHNICAL, LANDSCAPE AND BIOCLIMATIC APPROACH TO THE PROCESS OF DESIGNING DETACHED HOUSES ON THE BASIS OF VILLARINO DE SANABRIA, ZAMORA, SPAIN

TECHNICZNE, KRAJOBRAZOWE I BIOKLIMATYCZNE PODEJŚCIE W PROCESIE PROJEKTOWANIA DOMÓW WOLNOSTOJĄCYCH NA PRZYKŁADZIE VILLARINO DE SANABRIA, ZAMORA, HISZPANIA

Abstract

The paper presents the results of the work which inherently makes use of the coherent approach to the process of designing single-family detached housing. In the process of architectural planning, the authors have considered the analysis of the location, environmental and landscape qualities, renewable energy installation as well as construction materials along with the technology of erecting single-family houses. The design concept presented in the paper is of interdisciplinary character and integrates the design parameters belonging to the following fields: technology, landscape architecture, bio-climatics and renewable energy.

Keywords: architecture, building, landscape, renewable energy

Streszczenie

W artykule przedstawiono wyniki pracy, które w sposób immamentny korzystają ze zbornego podejścia w procesie projektowania jednorodzinnego budownictwa wolnostojącego. W procesie projektowania architektonicznego uwzględniono analizę miejsca, walory środowiskowe i krajobrazowe, instalacje energii odnawialnej, a także materiały budowlane z technologią wznoszenia domów jednorodzinnych. Przedstawiona koncepcja projektowa wykonana jest z uwzględnieniem pełnej interdyscyplinarności i integralności parametrów projektowych z obszarów: technicznych, architektury krajobrazu, biolkimatyki i energii odnawialnej.

Słowa kluczowe: architektura, budownictwo, krajobraz, energia odnawialna

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1. Introduction

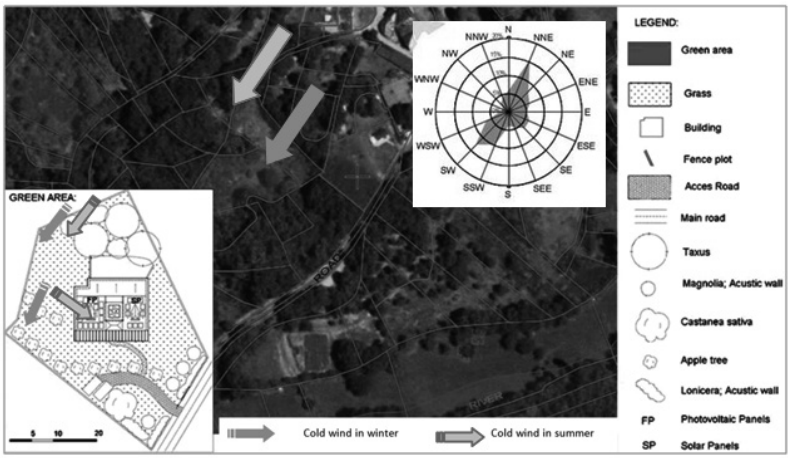
The methodology of construction design requires the integration of knowledge and experience of many elements which are parts of this process. The mutual interaction, implementation and permeation of particular activity stages make it possible to devise an attempt to define the holistic methods of achieving the design and final execution goal. The area of science dealing with construction design is very vast and on a common ground it combines many sciences which are fundamental to designing and especially in engineering. At the same time, the outcome of large-scale scientific exploration points to the need of including additional aspects in designing. They are connected for example,with respecting energy both in the production of construction materials, object erection, its use, modernization and finally, its liquidation. The process of design and construction execution should therefore be characterised by particular sensitivity and susceptibility to the changes which are the essence of various fields of science and experience while at the same time they are praxeologically implemented in the stages of both science and practice. The article presents the results of the work which inherently makes use of the coherent approach to the process of designing single-family detached housing.

2. Materials and methods

2.1. Methods and characteristics of the study area

In the process of architectonic designing account was taken of the analysis of the location, environmental and landscape qualities, renewable energy systems, as well as building materials in the technology of erecting detached houses [6, 24]. The presented concept is made with emphasis on the full interdisciplinary nature and integrity of design parameters from the: technical, landscaping, bio-climatic and renewable energy areas [3, 18, 28]. An exemplification of the article's assumptions is the design concept of the facility located in the town of Villarino de Sanabria (province of Zamora, Spain) [8]. The data taken into account in the article characterize the area selected for research, located in north-western Spain (they include: environmental, landscape, climatic, installation, functional and material parameters) and became the basis for conducting a broader analysis resulting in the elaboration of an organizational model solution. The town is located in the neighbourhood of the border with Portugal (north-western part of Zamora province) in a region which is characterized by diverse land shape, in terms of altitude and environmental qualities. Villarino de Sanabria is in a climatically diverse area i.e., on the borderland of zone I with a continental climate in and zone IV with a mountain climate. Zone I characterized by parameters of an ocean climate is also nearby. This area is dominated by variable winds with a south-west and north-eastern direction [23]. In the process of location and management of the plot (being the basis of the study along with the design concept of the facility), methods typical for landscape evaluation were applied, thanks to which the completed design is a coherent architectonic-construction-landscape whole (Ill. 1). This involved the use of the methods of: the value matrix by Bajerowski [1, 14], the impression curve by Wejchert [26], Visual Impact

Assessment (VIA) [2, 15], Zone of Visual Influence (ZVI) [17, 27], Viewpoints (as a part of Visual Impact Assessment) [10, 16]. The methods used have characterized and described the location parameters, emotional and aesthetic perception of the value and composition of the landscape.

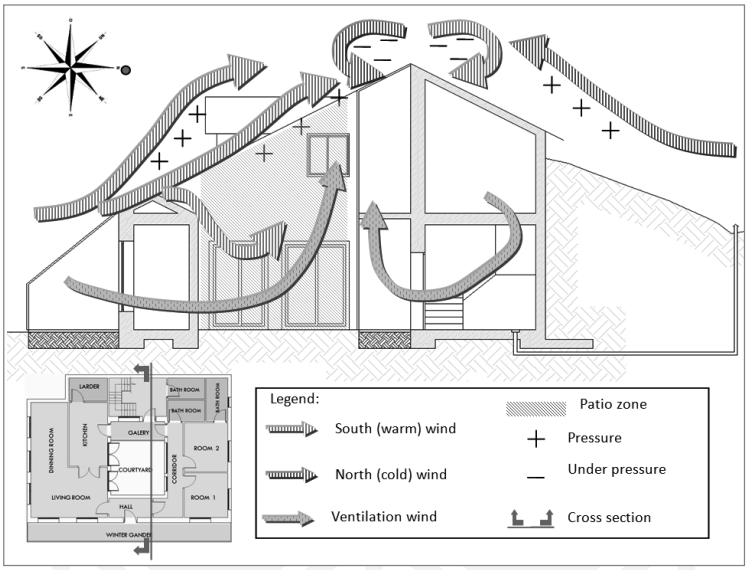


Ill. 1. Location of the facility and development of the plot (source: individual work on the basis of: SIG PAC, Junta de Castilla y Leon system)

3. Results and discussion

In connection with the implemented adopted research methodology, an analysis was carried out, which included coherent landscape, environmental, as well as material and architectural assessment. The adopted solutions are convergent with typical projects applied in this region while additional emphasis is placed on the consideration of the concept of selected methods of acquisition of renewable energy, as well as climatic and locational conditions. The whole is supposed to indicate a possibility of linking the needs of the inhabitants with the models of architectonic-material solutions [3, 5, 13, 20, 22, 24]. As a result, several aspects were enumerated, which refer to the selected problems. They include in particular the analysis of the possibilities of natural wind management in combination with the suggested functional-spatial solution for the house and its location in the area (Ill. 2) [21]. The use of the shape of the house and proper location of the facility on the plot taking into account the environmental parameters (height of location of the plot, planting greenery, open area, etc.), contributes a great potential of bioclimatic area [19].

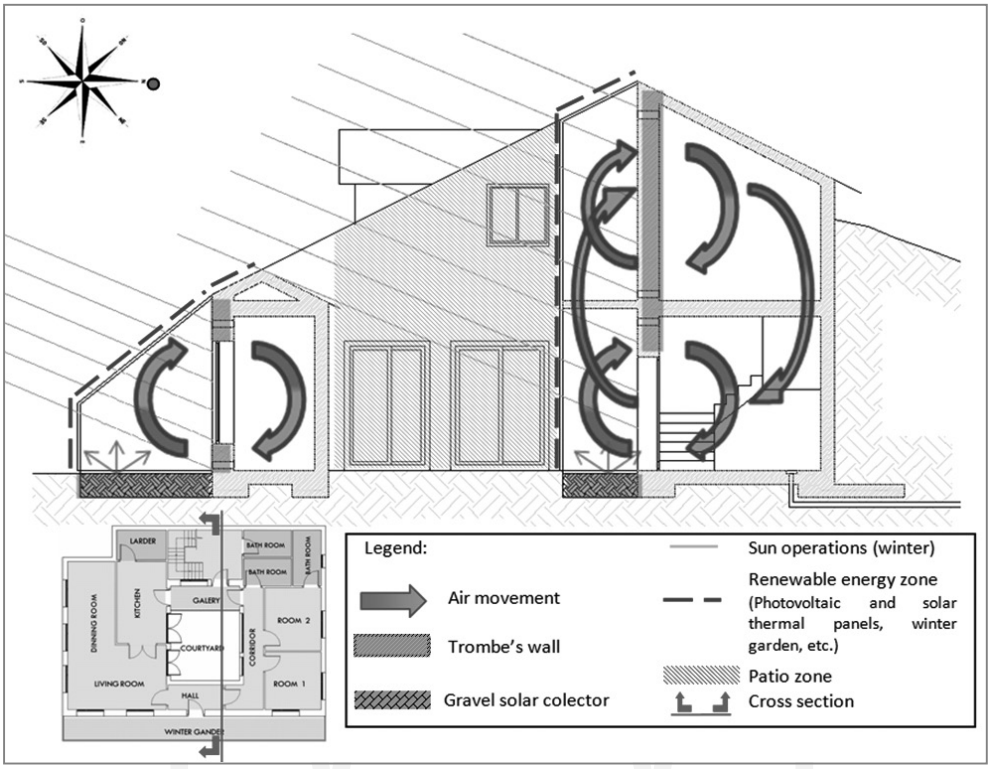
Pressure and negative pressure exerted by the wind become a natural driving force for gravitational air movement inside the facility [4, 9]. Thanks to combining this phenomenon with the designed spatial-construction solutions, it is possible to improve the living conditions of the house's inhabitants. This applies in particular to zones with prevailing directions of winds; in the analyzed case these are southern and northern directions. The body of the designed facility reflects the nature of the optimum trend in designing in this region. Reduction



Ill. 2. Projection and section of the house with wind movement zones (source: individual work)

in the southern part of the facade and elevating it towards the north leaving l internal open patio, enables control and prediction of the line of air movement inside particular modules of the house. This also applies to the northern side, where a particular problem may be cool winter winds. A similar procedure was applied for an analysis of the passive heating system. The diverse height of the particular parts of the facility, emphasizes in relation to the sun ray incidence angle, a large flat, oblique and vertical area, used in the implementation of several solutions of eco-energetic nature. They include photovoltaic cells and solar collectors [12], winter gardens, heat reservoirs (in the form of gravel tanks and accumulation walls), as well as multi-layer walls in the Tromba system (Ill. 3) [20]. The active surface is increased by the adopted modularity of the solution (joint use of various solutions), along with the patio forming an additional three glazed surfaces of walls (southern, eastern, western).

Owing to the geographic location of the assumption (warm climate), there is a need for cooling the facility, especially in the southern zones where there is a parallel increase in the level of natural humidity inside the rooms. For this purpose, an attempt was made to use solutions supporting cooling of the house with simultaneous reduction in demand for energy (Ill. 4). A hybrid solution was planned based on: a) combination of the force of natural wind (phenomenon of diverse pressure on both sides of the house and internal partitions), b) strengthening the speed of air movement inside rooms (in rooms equipped with reservoirs accumulating heat from solar radiation and with Tromba wall, c) air infiltration with reduced temperature and increased humidity coming from the northern side (sucked-in in a natural way and flowing from the place shielded by the house and greenery, and additionally cooled in the pipe placed a few meters under ground), d) cooling (in the summer) and heating (in the winter) with a layer of ground at the northern external partition (the ground is adjacent to the

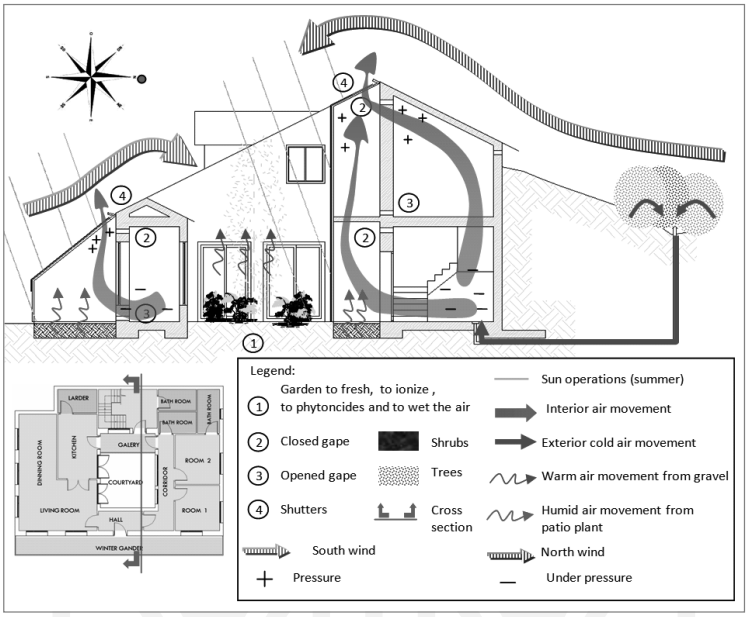


Ill. 3. Projection and section of the house with possible passive heating zones (winter) (source: individual work)

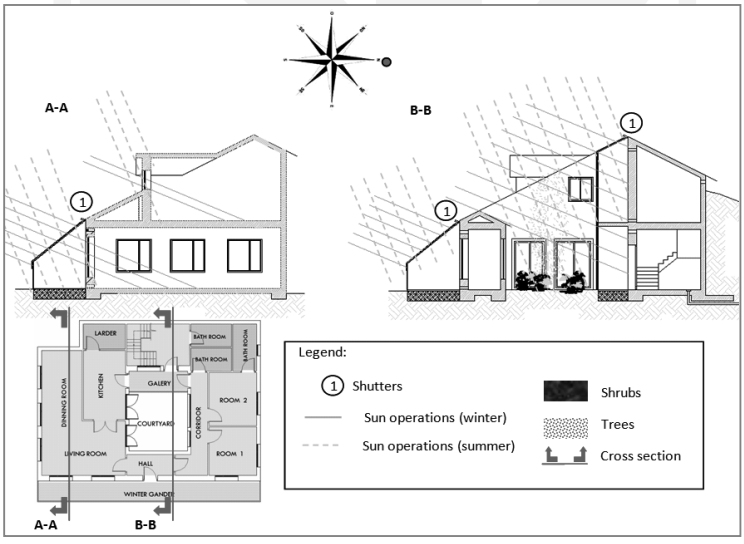
partition, which at the same time is a retaining wall, with the assumption that the facility is located in the area with a southern inclination), e) cooling, and at the same time, humidifying the air inside the patio (through the phenomenon of vaporization of water gathered in plants and lawns). The phenomenon of movement of air passing through intentionally (with regard to quality and place) planted plants, additionally ionizes the air and enriches it with phytoncides [3, 11, 17, 19, 20, 25].

An important aspect of the bioclimactic solution of the designed facility is the opportunity to make use of solar energy for lighting the interior. In the presented solution, analysis was made based on the possibilities of additional lighting in the all-season period (Ill. 5). Owing to the cascade nature of the solution and the application of surrounding glazed walls to the patio, considerable horizontal and vertical surfaces were obtained, on which direct and/or reflected solar radiation falls. In areas of excessively intensive solar radiation increasing room temperature, the possibility of covering with glazed surfaces is envisaged [4, 17].

A facility without a basement and with a partial attic requires a relatively large building area. It creates additional opportunities for the use of the ground area under the buildings for implementation of supporting devices and heating and air-conditioning solutions based on renewable energy areas (e.g., heat pumps).



Ill. 4. Projection and section of the house with possible passive cooling zones (summer) (source: individual work)



Ill. 5. Projection and section of the house with possible additional natural lighting zones (summer, winter) (source: individual work)

4. Conclusions

Data analysis and thematic query of the literature, indicate the need to define broader problematic fields accompanying the complex process of designing in architecture, construction, landscape, environment and eco-energy. The level of mutual relations in particular areas is individually estimated and matched to certain needs (including among others, the investor, the place, the environment) on the basis of the following remarks:

– bioclimate is immanently consistent with the process of interdisciplinary architectonic-construction designing,
– interdisciplinary approach to designing includes the analysis of environmental and landscape conditions,
– the main aspect when designing is to examine a possibility to introduce diverse methods of acquiring energy for renewable sources, with simultaneous respect for energy,
– each process of architectonic-construction designing should include a wide range of *ex-ante* analysis in the scope indicated in the article and *ex-post* analysis which will enable identification of a holistic design-executive method.

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