ABSTRACT: Vernacular architecture is a source of inspiration and guidance for the design of housing in a particular region, as well as for protecting and improving the environment, it shows the use of the proper material and can save energy costs, as these buildings cope with the climate through the passive design strategy.

The case study discovers the unmechanised architectural form of the elements, which react to the climate conditions on the built environment of the vernacular architecture. The cases are selected according to the Köppen climate classification calculated for the Czech Republic for the period 2071-2100, which is in the category Cfa, along with European cases in the same category Italy, Croatia, Serbia, Bulgaria, Spain, and Krasnodar-Russia. These representatives are observed by Google Street View, and the forms of the architecture are compared.

The potential of the research is to use the results in combination with architectural elements of the vernacular(1), contemporary(2) and ecological(3) housing architecture to design a new balanced housing model.

KEY WORDS: Non-mechanical design, determinism, climate-sensitive, indoor environment, social ecology, sustainable building, vernacular architecture
Introduction

The focus of the work is on independent housing units and their low-tech solutions. The study is focused on vernacular buildings of the early 19th and 20th centuries, which were mainly self-built, provided the necessary shelter for a home and have a local character. It examines elements of elementary architecture corresponding to one specific climatic type, specified by Köppen climate classification, the most widely-used system in the world.

The focus of the work on climatic conditions is based on the importance of climate-responsive architecture, which it achieves with its regional character. If the passive form of architecture is based on the given environment, there is no extra need for energy and CO$_2$ production to set up a healthy indoor environment. Already a passive form of architecture should respond to the climatic type of the locality in which the building is located.

The internal environment of buildings should primarily ensure the health of the inhabitants. Engineers today design a comfortable indoor environment, which is specified according to ANSI/ASHRAE Standard 55. Compliance with this comfort level is a question today due to the increase in energy prices and the sustainability of their consumption.

The aim of the research is to observe and combine the forms of vernacular architecture of the early 19th and 20th centuries in the identical climatic type Cfa, a humid subtropical climate. The investigated localities are in Italy, Croatia, Serbia, Bulgaria, Spain, and Krasnodar-Russia. The result is a set of characteristic building forms from different countries, which will be used to design an experimental prototype of a low-tech house in the documentation stage of construction.
Literature review

Vernacular architecture is a source of inspiration and guidance for the design of housing “in a particular region, as well as for saving and improving the environment” (Kazmee B. A. 2008), it shows the use of the proper material and can save energy costs, as these buildings cope with the climate using passive design strategies.

Figure 2.

The production and operation of buildings produces 40-60% of the carbon emissions produced by the industrialised world, so Daniel A. Barber (2019) proposes an architectural design that maximises the non-mechanical possibilities of heating or cooling.

The concept of Antifragility developed by Nassim Nicholas Taleb (2012) supports the thesis about vernacular architecture. In his book, he categorises the industrial and post-industrial era as fragile and nomadic tribes, hunters and gatherers as Antifragile. In this case the vernacular building can be at least in between this two, resistant in this volatile world.

As early as 1979, Lisa Heschong wrote: “We are not now inclined to regard modern heating and cooling systems as representative of a spiritual realm. The physical principles involved in their operation are thoroughly understood. There is no mystery about them.”

The current situation regarding climate, energy crisis, housing unaffordability and currently difficult to predict development, brings the need to rethink expensive and technologically demanding construction in favour of low-tech houses, which should benefit from this topic.
Figure 3. Šatov, Czech Republic

Figure 4. Spain
Methods and materials

The case study observes the vernacular houses in Europe in order to combine their form in the identical climate type. This research is counting the future calculation of the climate model for the Czech Republic using its Köppen-Geiger climate classification (Figure 1: Koppen-Geiger Map CZE future). The Köppen-Geiger system classifies climate into five main classes and 30 sub-types. The classification is based on threshold values and seasonality of monthly air temperature and precipitation. (Beck, H. E. et al., 2018). It is the most frequently used classification in the world and it depicts the whole world. The reason for choosing the climate type of the future calculated model is that the design strategy of the building is usually for the next 50 to 80 years and this calculation is already used as input when analysing the distribution or growth behaviour of species, or to set-up dynamic global vegetation models (Beck, H. E. et al., 2018).

Figure 5. Italy

It focuses on the South Moravian region in the Czech Republic, which is categorised according to the future Köppen Geiger climate classification map for the Czech Republic (2071-2100) (Figure 1: Koppen-Geiger Map CZE) as Cfa humid subtropical climate. A humid subtropical climate is a zone of climate characterised by hot and humid summers, and cool to mild winters. This climate features a mean temperature in the coldest
Cases of the single vernacular house are selected in the locality in the identical climate conditions type Cfa according to the Köppen Geiger climate classification map for Europe (1980-2016) (Figure 2: Köppen-Geiger Climate Classification Map). The locations are: Bulgaria (Kabile, Lyuben, Tseretelevo); Russia (Novolokinskaya, Novo Mikhailovskoe, Verevkin); Serbia (Beška, Kupinovo, Svranic); Italy (Piletta, Quassolo, ); Spain (Calders, Granera, Mura); Croatia (Plesmo, Šice, Timarci, Žreme). Selected cases were chosen in small villages, mainly close to national parks, because of their preserved historic quality or the main visual characteristics of the territory.

Representative of the South Moravian region in the Czech Republic

The three-part house used in warm climates is for basic living, sleeping and cooking. The arcade along the house serves as an outdoor living space protected from sunlight and functions as an outdoor living space. The roof was a hipped four-faced hipped roof.
Elements of the forms in the Barcelona region, Spain

The elements observed in the province of Barcelona are mostly covered outdoor spaces. The dwellings are complemented by shelter for outdoor seating or work. The roofs of the buildings are supplemented with ventilation holes, thus acting as ceiling insulators. There is also arcade in the attic that is open on three sides, shading the living space from the façade. The close development of the houses hides screened patios.

Elements of the forms in the Piedmont region, Italy

In the Piedmont region of Italy, we see the open front of a building. The immediate space under the roof is open and has the function of shielding the ceiling above the living room. These spaces can be completely open or enclosed by a perforated wall. The facades of these buildings are pre-set with 'pavilions' throughout the plan. This prevents direct sunlight from reaching the walls of the living room. The entrance to the house is also recessed in the second plan.
Elements of the forms in Sisak-Moslavina county, Croatia

Croatian inland buildings exhibit minor structural elements that struggle with climatic conditions. The entrance to the house is covered by a shed. The ground floor of the house is flanked by an eaves canopy, which also shades the summer rays. The windows are covered by shutters with slats that let in only direct sunlight. The outdoor porch area is elevated above the ground and open on three sides, allowing natural air flow.

Elements of the forms in the Belgrade region, Serbia

In Serbia, around Belgrade, houses are arranged perpendicular to the street line, the spacing between buildings is tight and there are entrances to the houses. Another feature observed is the ground floor lobby, which is raised above the ground. The roof of the house is extended in some cases, covering the entrance and adjacent area. The last example of vernacular construction shows a central building with a fireplace in the centre of the layout.

Elements of the forms in the Plovdiv region, Bulgaria

The Plovdiv region of Bulgaria is characterised by a very homogeneous construction. The roofs of the houses have a low slope and the plan of the buildings is L-shaped. The examples also show a semi-subterranean house with a cellar in the underground part of the building. The upper floor can recede to form a loggia.
Figure 9. Russia

Figure 10. Set model
Elements of the forms in the Krasnodar region, Russia

The area of Krasnodar, Russia, shows a built-up area heavily populated with trees, and satellite imagery shows that they have been planted in the built-up area. The buildings are compact and the entrance areas are often extensions. The courtyards are partially roofed. The houses have narrow and high windows.

Set model

This collage is a form of representation of research on characteristic building forms from different countries, which will be used to design an experimental prototype of a low-tech house. It serves as a first step in understanding these forms. These forms need to be subjected to further investigation; this paper seeks to find and name the forms. In the Set model (figure 10) are used forms of each country, researched in this paper. We can see the Set of the 6 different vernacular housing units contains a Bulgarian roof with a slight slope, narrow Russian windows (French windows), a Serbian chimney in the centre of the disposition, an Italian thick stone wall and free roof space, Spanish window sun protection and a Croatian veranda. From the selected cases we should get many more combinations of the low-tech house unit. We will be able to use them as the basic form of the proposal in the present and future context in designing the house.

Conclusions

Seeing the forms of the vernacular architecture in different regions is the source of inspiration for the future design of the housing units. Based on the observation and analysis of the selected examples, building forms suitable for the design of an experimental prototype low-tech house or housing units will be selected at the stage of construction documentation.

“Such approaches require the inter-disciplinary collaboration of academics working in the natural sciences, arts and humanities and social sciences.” (M. Vellinga, 2014)

We plan to approach experts in the fields of civil engineering and technology, sociology, medicine, economics, and other fields. The next phase of the research will be the actual implementation, i.e. the testing of our hypotheses in practice, according to the grant possibilities.
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