

NEOLITHIC ARCHITECTURE IN SERBIA AND SUSTAINABLE DEVELOPMENT

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SUMMARY:

*Sustainable development includes managing energy sources in the measure that makes possible a stable development of society during many generations. This includes the consideration of **renewable energy sources (RES)**. Designing buildings, as largest energy consumers, has a vital role in energy consumption of heating and air conditioning in the future. **Low energy buildings** are environmental friendly and there is a consideration for using construction ecological materials in recent times.*

Lepenski Vir and Belo Brdo – Vinča are the most known archaeological Neolithic places in Serbia. These dwelling places were used for a long time (Lepenski Vir for two thousand years and Vinča for a thousand years), which makes them interesting for analysis of sustainable development. They used only renewable energy sources. Interesting for us are settlement planning, individual houses and usage of ecological materials for dwellings.

If we research Neolithic tradition, as well as ancient and folk architecture in Serbia, we can get some answers for sustainable development for our society.

Key words: Neolithic, sustainable development, renewable energy sources, low energy buildings, natural buildings, cob

INTRODUCTION

Concept of **sustainable development** was proclaimed at the ministry conference in Bergen (Norway) in 1990. Idea of *sustainable development* includes integral economic, technological, social and cultural development which is coordinated with needs for environmental protection and advancement, and it makes possible better quality of life for present and future generations (see bibliography [1]).

“Sustainable society is the one lasting for many generations; it is farsighted, flexible enough and wise to disable the destruction of physical and social system which it is based on” (see bibliography [2]). Sustainable development means the environment protection by all mankind and using nature in the measure allowing its reproduction. Sustainability includes questions about: energy consumption, population, agriculture, industry, global warming, equality while using energy sources and urbanism. Basic role of sustainable development is the exploitation of natural resources only in the level which means regeneration. The idea of sustainable development means interregional and intergeneration equality.

Basic aim of the strategy for developing eco-technologies in energy engineering is to establish the application of new technologies for energy production and consumption which limit the environment destruction and pollution. Development and application expansion of **renewable energy sources (RES)** in energy engineering has a vital role in making sustainable development on Earth (see bibliography [3]).

“In this age we have to make the step towards a balanced resource management and a renewable energy-based society. Since the building sector is consuming about 40% of these resources, architects have a vital role in this process.” (Conference of PLEA 2004 – Passive and Low Energy Architecture, Eindhoven, Netherlands - September 19 - 22, 2004, on-line bibliography [4]).

Low energy buildings have a positive influence on environment, and using ecological materials for building is being considered in present time. These are the so-called **natural buildings**, made from natural materials with minimum influence on environment. Natural buildings can use **the cob** – the mixture of sand, straw and clay (see bibliography [9] and figure [1]).



Figure 1 – Natural buildings workshop by the architect Coenraad Rogmans, taken from on-line bibliography [9]

NEOLITHIC ARCHITECTURE AS A MODEL AND INSPIRATION FOR DESIGNING LOW ENERGY BUILDINGS AND SUSTAINABLE DEVELOPMENT

We can ask ourselves: why is the architecture of Neolithic people very interesting for present engineers and architects who are involved in sustainable development? The answer is simple: the society in Neolithic period looks like a society that applied concept of sustainable development. The reasons are the following:

- Their economy was based on RES, since the usage of fossil fuels came much later (they used wood for fire and solar energy for drying food and “walls” of their dwellings – passive solar gain);
- Environment pollution was minimal;
- They used only natural materials for dwellings which they found locally (wood, ground, clay, mud, sand, straw...);
- Their villages were alive for many generations, much longer than the industrial revolution lasted;
- They adapted their way of life in accordance with local climate conditions.

After this, we can make a conclusion that we cannot neglect or underestimate their skills in construction, urbanism and choosing place for settlements. Forgotten knowledge, together with the application of new technology, can contribute to a sustainable society in the future.

Lepenski Vir and Belo Brdo – Vinča are the most known Neolithic places in Serbia.

LEPENSKI VIR

Professor Dragoslav Srejsovic, PhD, was in charge of archeological research in the period between 1965 and 1968. Lepenski Vir is an excavation field located on the right bank of the Danube in the Djerdap Gorge. It is well known for its art sculptures, remains of urbanized houses, graves, general purpose objects and unusual ornaments. This abandoned settlement is estimated to be about 7,000 years old (according to bibliography [10] the existence of the culture of Lepenski Vir by C-14 method was between 6,500 and 4,500 B.C. – in other words, for two thousand years). The specific “Djerdap climate” is featured by somewhat milder winters and moderately hot summers, with a later temperature maximum (see bibliography [5]). Lepenski Vir inhabitants did not know for the orthogonal architecture, which is very important for passive solar gain. There are no written traces of their knowledge.

There are papers on passive solar and bioclimatic architecture in Lepenski Vir (see [1], [6] and [8]). In connection with sustainable development, we will point out the following:

- Architects at Lepenski Vir had a knowledge and skills of geometry, elementary geography (knowledge of orientation), elementary meteorology (choosing an optimal microclimate), knowledge of thermal comfort materials, elementary heating technique (knowledge of passive solar gain) and knowledge of making dwelling materials;
- Village and houses were adapted for and located in climatic environment in the best possible manner;
- Homes were oriented toward East (the river) and the whole site was in shade after 3 p.m. Orientation of houses allowed maximum of solar radiation in the morning, when it was needed to dry house “walls” after cold nights;
- The shape of the house bases is considered by solar architecture to be exceptionally beneficial and energy-saving;

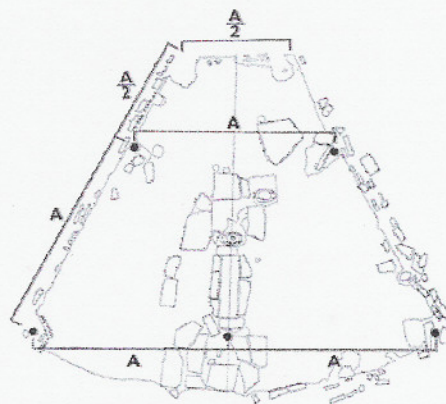


Figure 2 –House basis in Lepenski Vir (taken from bibliography [5])

- The walls were placed at an angle; this enabled fast drying of the materials under the influence of the sun;
- Thermal insulation was made by digging in or filling walls with earth;
- The floor from red limestone was a good passive solar absorber and heat storage;
- Vertical and horizontal asymmetry of the houses, as assumed by Srejavic, may also contribute to saving the energy for heating;
- Additional heating in this case was obtained through a fireplace fitted in the floor, as a form of floor heating; it was main structure mass;
- Original way of planning the settlement (they did not know orthogonal architecture);
- Inhabitants in Lepenski Vir had exceptionally comfortable homes for that period. This is corroborated by the already established fact (see bibliography [5]) that skeletons of Lepenski Vir inhabitants did not show any other diseases except for spondilosis; some of them died in very old age. Therefore, there were no traces of rheumatic processes which occur due to humidity or cold, which could be expected having in mind the humid climate at the site.

That is why architecture of Lepenski Vir also serves as a signpost and inspiration for energy saving in ecological village in Temska, near Pirot, Serbia. The architect of solution was Jelena Šubarević from the Faculty of Technical Science in Kosovska Mitrovica (see bibliography [7]).

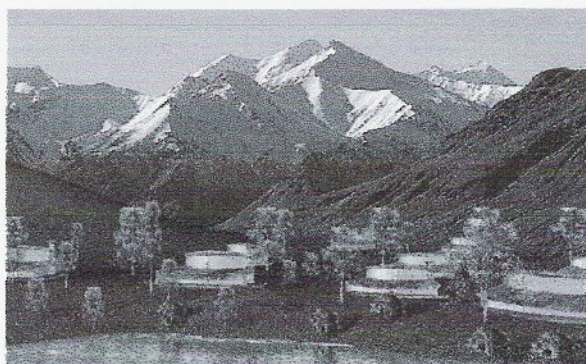


Figure 3 – Computer animation of ecological village Temska by architect Jelena Šubarević

BELO BRDO – VINČA

The Belo Brdo is an archaeological site in Vinča, on the right bank of the Danube, 14 km downstream from Belgrade, Serbia. The first archaeological excavation in Vinča was undertaken by Miloje M. Vasić in 1908 and the excavation has continued until today. The remains of the settlement in Vinča are in the cultural layer 10.5 m high and dating from late Neolithic period (between 4,500 and 3,500 BC, see bibliography [11]).

Based on scarce remains of the oldest settlements discovered at about 10.5 m below the surface, it might be concluded that Vinča was inhabited first at the time of decline of the middle Neolithic Age, around 4,800 BC and their earth-cabin homes had round or elliptic base shape, buried into wood, with roof made of straw, cane and brushwood. Above it, first dwellings were newer settlements of different type: the bases were quadrangle, oriented towards SE-NW and the walls were vertical.



Figure 4 – Animation of Vinča house (taken from bibliography [12])

Lumber and clay were continued to be used as building materials, but the building process was enriched by new details and skills, such as leveling, foundation stabilization and insulation. Later, there were larger houses, with a number of rooms, even with “furniture”. Their houses were made “in line“, like old houses in Vojvodina, with orthogonal streets.

The floor had two-layers (see bibliography [14]): first layer was in wooden half cylinders, and above it was clay layer. So, there was an insulation wooden layer, which enabled inside temperature preservation. Under those layers, there was a layer from broken pottery, probably for leveling the ground. The house walls were very thick, made of clay with straw and cane. The cane bandaged wooden pillars, two meter high (half meter underground) and pasted with mud.



Figure 5 – Photo of two-layer floors in Vinča (bibliography [15])

They avoided places with potential floods. But, their houses were inflammable, because we found scents of fire. The houses had a stove for heating and cooking and smoke from the fireplace could be directly connected to the atmosphere – probably without a chimney.

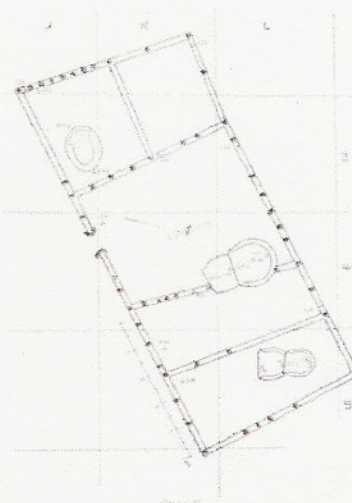


Figure 6 – Orientation of house in Vinča (bibliography [15])

CONCLUSION

Sustainable development is an imperative for human society. If we wish a long-lasting civilization, we must research for renewable energy sources, energy consumption and construction techniques for building low energy and natural structures.

Neolithic society is an example of sustainable society, because it lasted for many generations. So, that is why their building experience is important. Lepenski Vir (early Neolithic Age) and Belo Brdo – Vinča (late Neolithic Age) are the most known archaeological places from Neolithic Age in Serbia. This paper shows positive experience in accommodating the climate by Neolithic people. Also it shows architecture of Vinča, which has been a basis for folk buildings until today. Construction of floors in Vinča is very interesting. Architecture of Lepenski Vir is an inspiration for project of ecological village Temska, near Pirot, Serbia.

If we research Neolithic tradition, as well as ancient and folk architecture in Serbia, we can get some answers for sustainable development for our society.

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