



## **The Concept of the Complex Program of Preservation and Use of the Landscape and Architectural Complex “Pidhoretskyy Castle” (Lviv region, Ukraine).**

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### **ABSTRACT**

The landscape and architectural complex “Pidhoretskyy Castle” was one of the first museum complexes which started to develop in the 18<sup>th</sup> century on the territory of Ukraine. Owing to the convenient location and valuable collection of artworks, the castle became well-known in the countries of Eastern Europe in the 19<sup>th</sup> and first half of the 20<sup>th</sup> centuries. The total area of the landscape and architectural complex “Pidhoretskyy Castle” makes 170 ha.

The report presents the Concept of the complex program of preservation and use of the landscape and architectural complex “Pidhoretskyy Castle” (the Concept), which includes conduction of scientific researches, elaboration of the general plan, creation of international museum and ethnographic exhibitions and tourism-recreation objects as well as proper transport and tourism infrastructure which will boost investment projects. While implementing the complex program of preservation and use of the “Pidhoretskyy Castle” complex there is foreseen the use of ecological alternative energy sources (AES) as one of the necessary components of energy efficiency and energy saving based on European experience.

### **THE LVIV NATIONAL ART GALLERY**

The Lviv National Art Gallery is one of the oldest museums in Ukraine. There are over 60,000 museum exhibits in its depositories. Today the Lviv Art Gallery is one of the richest museums of Ukraine as its collection numbers over 62 thousand international and national artworks from ancient times to the present day. The most valuable are the collections of the European art, Lviv sculpture, the Ukrainian portrait 16-19<sup>th</sup> centuries, icons and furniture.

The Art Gallery consists of 16 bigger and smaller museum complexes as well as individual small museums operating as individual museum departments. Those are as follows: “The European Art 14-18<sup>th</sup> centuries”, “The European Art 19-21<sup>st</sup> centuries”, “The Boims’ Chapel”, Museum of Art of the Ancient Ukrainian Book, Museum “The Dniester Mermaid”, Museum of the Lviv Ancient Sites, “The Baroque Sculpture 18<sup>th</sup> century by Johann Georg Pinsel”, Museum-Studio of Teodoziya Bryzh, Mykhaylo Dzyndra Museum of Modern Sculpture, Museum-Estate of Markiyan Shashkevych, Museum “Pyatnychany Tower”, Museum of Ivan Vyhovskyy, the

Oleskyy Castle Museum-Preserve, the Zhovkva Castle Museum-Preserve, the Zolochiv Castle Museum-Preserve and the Pidhirtsi Castle Museum-Preserve, Fig. 1.

The Pidhirtsi Castle (49°56'35.69"C Northern Latitude, 24°59'0.68"B Eastern Longitude) is one of the best combinations of the imposing palace with bastion fortifications in Europe, Fig. 2, 3. The palace was built in 1635-1640 to the project of the architect Andre del Aqua and the engineer Guillaume Le Vasseur de Beauplan. The palace was commissioned by the owner of Pidhirtsi—the Grand Crown Hetman of the Polish-Lithuanian Commonwealth—Stanisław Koniecpolski. The author of the palace decorations was John the Baptist Falconi. The portals and fireplaces were designed by Constantino Tenchella. The Chapel of the Sorrowful Mother was the most lavishly adorned.



Fig.1. The Engraving by Karol Auer 19<sup>th</sup> century “The Pidhirtsi Castle”



Fig.2. The Pidhirtsi Castle (a present-day picture 1)



**Fig.3. The Pidhoretsky Castle (a present-day picture 2)**

### **THE COMPLEX “PIDHORETSKY CASTLE”**

The castle ensemble consists of the Castle, the Hetman Wayside Inn 18<sup>th</sup> century, the Catholic Church mid-18<sup>th</sup> century (architect K.Rymlyanyn) and the state park-monument of garden-park art. At present the repair-and-restoration works are conducted.

Owing to the unique park complex, the large collection of artworks and weaponry, household articles as well as the activities of the theatrical circle, the Castle became one of the most popular cultural centers with visitors in the 18-19<sup>th</sup> centuries until the First World War.

In time of war actions between Austrian and Russian forces their commandants forbade firing after mutual negotiations, having taken into account the significance of the Castle as a museum and cultural center. However, during the Polish-Soviet War the Castle was damaged with “the exceptional vandalism” as a chronicler mentioned as a result of the First Cavalry Army break-through.

During the interwar period the Castle was restored. However, the damaged artistic collections were never the same like before the war. During the Second World War the site was spared. Unfortunately, the postwar period caused the irretrievable damage to the Castle. The artistic collections were plundered and their remains were given over to Lviv museums. The castle palace was converted into TB treatment health resort.

In 1954 the castle palace got burnt as a result of lightning strikes. The fire ruined the unique carved wooden ceilings with paintings as well as the artistic adornment of the second and third level interiors.

In the 1990s the site was given over to the Lviv Art Gallery and it received the status of an exhibition object. Since then the site roused the potential interest. In spite of considerable

losses the Castle is still attractive for visitors. Every year lots of Ukrainian and Polish tourism groups visit it. The number of individual tourists including foreigners increases as well.

The restored and adapted complex monuments, the regenerated park ensemble, the arranged territory of the ancient Rus fortified town of Plisnesko (whose history is connected with the Varyags and White Croatsians), and the well preserved picturesque outskirts landscapes can serve as a basis for creation of the international museum and tourist recreation center.

The reproduction of especially valuable interiors of the first floor of the castle palace and adaptation of the second floor premises create an opportunity to use the castle and park ensemble for occasional international governmental meetings and talks.

One of the most important factors of functioning of the museum and tourist recreation center is creation of proper transport and tourism infrastructure which will serve as a basis for its future development and boost the implementation of investment projects.



**Fig.4. Present-day picture of the Pidhirtsi Castle**

At present the Foundation “Pidhoretsky Castle” in association with the Lviv Art Gallery make efforts for regeneration of the former museum complex.

One of the main tasks, which will arise in the process of regeneration, is the creation of the effective system of the object energy supply. Otherwise, it will be impossible to provide the proper regime for keeping and exhibiting the unique artistic collections.

The considerable distance of the object as well as the absence of constant source of power supply, make it difficult to implement the determined tasks.

### **Ecological alternative energy sources.**

The attraction of the alternative autonomous energy saving sources can be a weighty factor in solving the question of object regeneration and its functioning as a museum and tourist recreation complex.

While implementing the complex program of preservation and use of the landscape architectural and tourist recreation “Pidhirtsi Castle” complex there is foreseen the use of

ecological alternative energy sources (AES) as one of the necessary present-day components of energy efficiency and energy saving on sites of historical and cultural heritage of Europe.

While working up the energy supply system for the “Pidhirtsi Castle” complex, the following factors were taken into account:

1. One of the main program tasks is preservation of the landscape and architectural ensemble of the Pidhirtsi castle. Therefore, only partial use of modern energy-saving technologies is possible for the restoration of the complex buildings and reproduction of their decoration elements;

2. The “Pidhirtsi Castle” complex is located in a hilly area (Fig.4.). Therefore, very long surface linear constructions cannot be used for the AES;

3. The application of the AES should not diminish the attractiveness of the castle appearance and its outskirts;

4. The methods of application of the offered AES should meet the needs of the castle objects as well as tourism recreation infrastructure of the area surrounding the castle.

5. The energy supply system must be maximum ecological. It should not influence negatively on the construction elements of the Pidhirtsi castle complex.



**Fig. 5. The complex “Pidhoretskyy Castle” territory.**

In Europe the application of the AES is stimulated at the legislative level. The share of the AES in the EU member countries should make not less than 15% in the internal energy balance. In the EU they successfully apply the AES on the objects of historical and cultural heritage. For example, in the Drottningholm Palace of the Swedish royal family in 1985 there was installed the geothermal heating system with the application of the heat pump 300 kW in capacity. The positive European experience should be used in Ukraine.

In general, the energy supply system of the Pidhirtsi castle complex as well as the tourism recreation infrastructure require about 0,8 - 0,9 MW of the established electric power and 1,7 – 1,9 MW of thermal energy, which will mostly be used in the winter. In the summer it is necessary to provide the proper air cooling and conditioning in the castle premises to maintain the optimum conditions for keeping the museum exhibitions.

Taking into account the indicated factors and needs in energy supply, there were considered the systems based on solar energy, wind energy, biomass energy and geothermal energy (heat pumps) as examples of the AES. Let us analyze the conceptual possibilities of the use of the indicated AES for the establishment of energy supply system.

The use of solar energy requires the installation of photovoltaic panels or heliocollectors on the roofs of buildings or on separate special surface constructions which is not acceptable for the castle objects. However, it can be used on the infrastructure objects which are located far enough from the castle complex. The substantial disadvantage of the solar systems is the considerable dependence of the energy value on the number of sunny days and the intensity of solar radiation which are not sufficient for the complex location.

For the use of wind energy it is necessary to install over 40 m tall wind devices and to provide energy in accordance with all the required standards. It is clear that the use of tall wind turbines on the territory of the Pidhirtsi castle is unacceptable since it will spoil the scenery of the historic and architectural site. Moreover, the use of wind energy does not ensure the stable power supply.



**Fig. 6. The Pidhirtsi Castle (a present-day appearance)**

The use of biomass fuel foresees the required amount of biomass (mostly wood) or purposeful growing energetic plants (for example, willow-tree) on the allotted land plots. The creation of biomass-based power supply system does not appear to be real and reasonable, because there are no free land plots on the castle complex territory which could be used for the growing of biomass, and using biomass as a fuel produces air pollution which can negatively influence the Pidhirtsi castle complex.

The use of geothermal energy by extracting heat from the ground (groundwater) and the applying of heat pumps appear to be the most reasonable and ecologically proven decision. However, as the Pidhirtsi castle complex is located on an elevation with the low level of groundwater, the arrangement of deep wells (over 500 m deep) directly on the castle territory is pointless. The arrangement of boreholes at the foot of the hill to the north and to the west of the castle is more acceptable, Fig. 4. In this case, the wells will be drilled to a depth of 150 m. The number of wells to be drilled will be 5 to 8. The extracting heat from the ground will be conducted

by means of periodic pumping out of water and driving it up to the heat pumps which will be installed in the equipped castle subsidiary premise. For providing heat for the castle there will be enough 2 – 3 heat pumps each 150 – 200 kW in capacity or 3 – 4 heat pumps 120 – 150 kW in capacity. Moreover, the application of heat pumps will provide the hot water supply for the objects without additional energy loss throughout the year.

The following heat pump manufacturers are recommended for the installation of heat supply system in the Pidhirtsi castle complex: Watercotte (series DS 5110 and DS 5240), BOSCH, KWT, OSHSNER (Standard, R – Retrofit) and other Europe's and world's leading manufacturers.

The advantage of the energy supply system by means of heat pumps is the ecological safety (absence of any emissions) and the stability of geothermal source of energy.

From the above stated the following conclusion can be drawn: the geothermal-based energy system with heat pumps is the most efficient and stable power supply system for the Pidhirtsi castle.

For the infrastructure objects there can be offered the individual or collective power supply systems based on geothermal energy with the use of heat pumps of different capacities. The configuration of such purposeful systems will be determined while projecting the infrastructure objects.

The economic indicators are significant for the introduction of the alternative power supply systems. The indicators must be the same or better than the correspondent indicators of systems based on traditional energy resources (natural gas, coal and oil products). It should be noted that the economic indicators of the power supply systems based on the AES are individual and depend on concrete conditions, constructions and methods of fulfillment. The use of certain kind of the AES can be effective and repaying in one case and disadvantageous in other case. Moreover, the ecological solutions, which are less harmful to the environment, always require more efforts and expenses than the simplest solutions. For example, direct burning causes environmental damage.

In our case the economic indicators of the power supply system efficiency in the Pidhirtsi castle complex characterize two parts. The first part—the costs for system establishment and the second part—the exploitation costs.

The costs for system establishment include the costs of the heat pumps, the system materials and construction-mounting works. At the assessed valuation of the system amounting to 320 – 350 thousand €, the cost of the heat pumps will not exceed 30%.

The total value of the heat pump system exceeds the value of the corresponding system based on the traditional energy resources 1,5 – 2,5 times.

The exploitation costs of the heat pump system include the required materials, maintenance and service costs. The same costs for the traditional systems include the cost of energy sources and the utilization of combustion by-products. Therefore, the exploitation costs for the heat pump system are 3 – 4 times lower.

In comparison with the traditional systems the recouplement of the geothermal heat pump system for the Pidhirtsi castle complex will make 6,5 – 7,5 years.

Depending on the peculiarities of the fulfillment of the individual or collective power supply systems for the Pidhirtsi castle infrastructure objects, their recouplement will make 7 years as well.

While the accomplishment of the preservation and use program of “Pidhoretsky Castle” landscape architectural and tourist recreation complex, the use of the ecological AES – the geothermal heat pump energy will ensure the energy saving and efficiency on one of the most significant sites of historical and cultural heritage of Europe in Ukraine.



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