Water Management Complexes as Objects of Recreation and Ecological Tourism

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June 9, 2020

WATER MANAGEMENT COMPLEXES AS OBJECTS OF RECREATION AND ECOLOGICAL TOURISM

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The authors consider water management complexes and their use as recreational objects and objects of ecological tourism. The potential social significance of constructing such complexes is shown. Based on the analysis of international experience, the main guidelines for the use of waterworks structures of water management complexes as objects with recreational and tourist attractiveness are determined. The authors illustrate the arrangement of special observation decks at water-retaining structures and reservoirs, the arrangement of places for organized recreation on eco-tourism routes, various recreational attractions, the creation of recreational park areas, historical and educational sites, as well as the formation of objects that can be recognized as historical, cultural and technical monuments.

Keywords: *water management complex, water management facility, hydrotechnical structures, reservoir, dam, recreation, tourist facility.*

Introduction.

Traditionally, retaining hydrotechnical structures have been and are currently built with the aim of creating a concentrated difference in water levels (pressure) of a water body. At the same time, a water management complex is being formed, the reservoir of which is used for various economic purposes, the main ones being power generation, water supply to industrial enterprises and various settlements, as well as providing favorable conditions for water transport [1-7]. In this regard, the most important requirements for hydrotechnical structures include the reliability and safety of their operation, the strength and water resistance of retaining structures, their durability and economic efficiency [8-13].

In addition to these traditional approaches to hydro-engineering construction, in many countries of the world, waterworks and their structures are used as recreation facilities. For this purpose, directly at or near the structures, special observation (viewing) platforms, organized recreation areas for participants in nature tourism, recreational and park areas, recreational attractions for tourists, historical and educational sites, etc. are arranged. This means that hydropower facilities, in addition to the well-known technical properties and industrial efficiency parameters, must also be characterized by highly demanded social and consumer qualities.

Methods.

The authors considered a number of water management facilities, their composition and operational features, including their purpose and attractiveness as recreational facilities. The real objects that are currently functioning were analyzed. Based on the information of open access publications, as well as on the materials of inspections during personal visits to sites, their recreational potential was assessed, and methods used to increase the attractiveness of water facilities were analyzed.

Results and Discussion.

The simplest method to increase the recreational potential of a water management facility is the arrangement of special observation decks. An example of such a solution with the arrangement of an attractive observation point with the view of the waterworks facilities, mountain landscape and the reservoir is the Oymapinar waterworks (Turkey) located on the Manavgat river. The hydroelectric facility was built from 1077 to 1984, and its 185 m high arch dam forms a 500 ha reservoir of a pronounced emerald color. The reservoir and the surrounding area are called the Green Canyon.

Such solutions for the arrangement of observation points are most widespread throughout the world. Similar solutions are used at many international high-pressure hydro units, e.g. three gorges on the Yangtze River (China), Itaipu on the Parana River on the border of Brazil and Paraguay, Guri on the Caroni River (Venezuela), Tucurui on the Tokantins River (Brazil), Grand Cooley (USA), Luntan (China), Hoover on the river Colorado (USA) and others, as well as at Russian sites: Sayano-Shushenskaya and Krasnoyarskaya on the Yenisei River, Ist-Ilim and Bratskaya on the Angara River, Chirkey on the Sulak River and other hydroelectric power stations .

Much less often, hydrotechnical structures are used for creation of recreational places for participants in natural tourism. A typical example of such a solution is the Vidraru waterworks facility (Romania).

A picturesque traffic road is set up to the arch dam of the Vidraru hydroelectric power station and its viewing platform in a mountainous area with serpentines. The arch dam of the hydroelectric complex was built in 1965 on the Arges River and is now known as the highest dam in the country. It is located in the gorge and provides a rise in water level in the mountain lake of the same name. The road along the arch dam crest is an important component of the Transfagarasan tourist mountain road, which runs from the north to the south between the Transylvania and Wallachia regions and rises to a mark of 2030 meters above sea level. The 100 km road was built in the 70s of the last century. Now the road is used almost only in summer, has exclusively tourist significance and is in demand as an element of the natural and ecological recreational zone.

The next group includes waterworks with equipped recreational sites and (or) separate recreational attractions for tourists. The arch dam of the Verzasca hydroelectric power station (Switzerland), built on the river of the same name in the mountains of the Ticino canton in the Italian part of the country, can serve as a representative of such waterworks structures.

Only a pedestrian crossing is arranged along the crest, which is very actively visited by tourists.

The tourist attractiveness of a high-pressure arch dam (220 m high with a wide width of 380 m) and a beautiful lake (reservoir) Vogorno is due to two factors. The first is a bungee located directly on the crest of the dam, which is one of the highest of operating attractions of this kind. Tourists can jump from the dam (for a fee), and numerous spectators can witness their free flight and become members of the jumpers support group. The second factor is the rare transparency of the water in Lake Vogorno. This factor attracts scuba diving enthusiasts. Consequently, the area where the Verzasca hydrotechnical structures are located are full of tourists enthusiastic about diving.

Significantly more complex structures with the inclusion of high- and medium-pressure hydroelectric dam units are characteristic of recreational and park areas. Such complex facilities in the territories of mountainous regions in countries with developed tourism business are particularly attractive. A striking representative of such complexes is the LongQingXia (龙庆峡) park - Lon Chin Xia (China) with an arch dam [23].

The park is situated about 100 km away from Beijing. There are several hotels for tourists located directly at the park . The park itself has a lot of elements that are characteristic for tourist areas: strings of Chinese red lanterns, a park map with pointers, fish ponds, waterfalls and fountains, the key object of the landscaped park area is an arch dam, erected in a narrow canyon and forming a beautiful reservoir, an escalator rise to the reservoir, arranged in the form of a dragon's body along a slope of a rock, tunnels in the rock massif, mountain paths, many viewing platforms, souvenir shops. A boat trip can be taken along a narrow winding reservoir among the high cliffs with a stop near a high bungee swing. After a boat trip, those who wish can take a cable car ride to the mountainous part of the park area to a small Buddhist temple and mountain arbors. From the dam on, the descent is equipped with a thematic pedestrian tunnel and downhill on wheeled trolleys.

A separate group of waterworks is represented by structures that play the role of historical and educational sites or monuments of history, culture and technology. Such use of hydroelectric facilities is greatly developed in Poland, where the use of potential and kinetic energy of streams and small rivers began to be carried out long before today, especially in the territory of Pomerania. It is not surprising that it is in Poland that a clearly respectful attitude to the accumulated rich experience in the construction and operation of waterworks structures has been preserved, and now a clear desire is expressed to preserve the technical achievements of past centuries for current and next generations [24].

Currently, a technology museum is successfully operating in Poland, in which the exhibits are not recreated mock-ups or just individual objects of past times, but real structures built in past centuries and preserved to this day. Among the various thematic cultural and educational routes offered to tourists, there is a route that involves the acquaintance with the monuments of waterworks engineering and hydropower. The list of objects for this route includes more than fifteen waterwork engineering facilities, among which are ten hydroelectric power plants operating or maintaining operability at present.

It should be noted that the small rivers of Poland have significant hydropower potential, which since the end of the 18th century has also been used for electricity production. Pomerania in Poland belongs to the regions that have the best conditions for using the energy of small rivers. That is why here, on the Slupia River, the first hydroelectric power plants were built. The catchment of the Slupia River is located in the northwestern part of Pomerania. The length of the river is almost 140 km, and the total catchment surface is 1600 km^2. The source of the river is located at an altitude of 178 m near the town of Sierakowska Huta, and the mouth is located at the level of the Baltic Sea [19].

First, mills and sawmills were built on the Slupia River. And the first hydroelectric power plant, used as a source of electricity, the Struga hydroelectric power station was launched in 1896. The brick building, previously used as a mill, a sawmill, and, more recently, a cardboard manufacturing plant, was used to house its power unit. In the period from 1889 to 1896, re-equipment of the hydroelectric power station was carried out. Later, a radial-axis hydroturbine was installed at a small hydroelectric station. The turbine operates at a pressure of 14 m and has a flow rate of 2.7 m^3/s. The turbine drives a synchronous generator with a belt drive [25]. Hydropower equipment is still operating.

Among the objects of this route, containing waterworks engineering monuments, one can also see the hydraulic power unit, the so called *Historical Water Mill in Oliva*. It is believed that earlier in the XIII century, this memorial building served as a mill of a large plant of that time, located on the Oliva water stream. Later, this object was rebuilt in a forge. Due to the fact that two large hammers operated in the forge, the written sources in 1597 also called it a "hammer forge". Since the beginning of its operation, two iron forges worked on the water stream. The Great Forge now houses a museum. The Small Forge has always brought significant profit due to the production of iron products. In 1975, the museum of technology became the owner of the mill as a historical monument. The destroyed building and equipment were repaired. The museum opened to the public in 1978. [26].

Fig. 1 shows a general view of the power plant in Oliva and the hammer. The impeller is a rim made of wooden bars placed on the frame. Blades are attached to the rim, affected by the flow of water. A massive oak shaft is used as the installation axis.

Fig. 1. General view of the power plant in Oliva (Poland) [20]

In general, the forge equipment consists of three water wheels, two massive oak shafts, hammers and large scissors for cutting iron. The dam, two outlets and a "large blacksmith pond" are located near the forge, preserved in their original form. The operation of the forge can be demonstrated when forging metal souvenirs for visitors.

The preservation of such hydrotechnical engineering facilities and historical hydro-power equipment as monuments of engineering and public heritage can be distinguished as a separate way of using engineering structures, which provides an increase in the tourist attractiveness of the territory, and can also make a certain contribution to raising the educational and cultural status of the community living on it and its guests.

From the analysis carried out, it follows that the main areas of use of water management and hydroelectric facilities (which increase their social, health care and cultural significance) are: placement of special observation decks, arrangement of recreation places for those following the eco-tourism routes, arrangement of recreational attractions, recreational and park areas, creation of historical and educational sites, as well as objects with the status of protected monuments of history, culture and technology.

Conclusions

1. The analysis of the main areas of use of operated water management facilities with pressure hydrotechnical structures was carried out, which showed that along with traditional approaches (energy, water supply, water transport) in many foreign countries and in Russia, water management structures are also used as recreational and ecological tourism facilities.

2. In order to increase the social, recreational and cultural significance of water management facilities, the following are used: placement of special observation decks, arrangement of recreation places for those following the eco-tourism routes, arrangement of recreational attractions, recreational and park areas, creation of historical and educational sites, as well as objects with the status of protected monuments of history, culture and technology.

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