AN ATTEMPT TO EVALUATE THE IMPACT OF SELECTED METEOROLOGICAL ELEMENTS ON THE THREAT TO THE INTERIOR OF THE HISTORIC CHURCH IN DĘBNO PODHALAŃSKIE

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The work present a preliminary evaluation of the impact of certain weather factors on the threat to the interior of a Class "O" object, the church in Dębno Podhalańskie. Among a wide array of threats, the construction of a dam on the Dunajec could have an impact in the future on changes in certain climatic elements in the vicinity of the reservoir, and as a consequence changes in the natural and cultural environment. This work, expected to be a multi-year project, is intended to take appropriate steps to prevent any possible threat to this unique church.

The church in Dębno is not only noteworthy as an individual object of Class "O", under custodial protection. It also constitutes a very particular element of the cultural landscape of this region, among the unique architectural monuments of Podhale and Spisz: the old watchtower castles in Niedzica and Czorsztyn, the checker-board fields, the network of roads, the forest greenery.

Until recently, the activity of Man on the border area of the Orawa - Nowy Targ Valley and the Pieniny Mountains had not caused any significant turbulence in the equilibrium between natural space and the artifacts of civilization. In recent years, however, the threat to the natural and cultural environment has intensified, due to such hazards as the emission of long-range atmospheric pollutants from the Czech Republic and Slovakia, and the building of dams on the Dunajec, with all the attendant consequences (changes in water relations, and consequently in the habitat conditions). As the work has progressed on the construction of the complex of reservoirs in Czorsztyn-Niedzica and Sromowce Wyżne, a number of institutions have initiated the appropriate monitoring, in order to assure that the facilities are functioning properly, and to trace the future changes in the natural and cultural environment around these reservoirs.

The organization and conduct of monitoring of the microclimate in the interiors of historic buildings, against the background of variances in external meteorological conditions, is being handled by the Chair of Agricultural Meteorology and Climatology at the Cracow Academy of Agriculture. The systematic recording of the course of selected meteorological elements of temperature and relative humidity began on October 1, 1995.

Broadly conceived, the research problems presented in the present paper are a continuation of the organized continuing monitoring of the reservoir's natural environment, and indeed the drainage basin of the upper Dunajec, and especially one aspect of that monitoring, namely the monitoring of historic buildings. On the other hand, this can be treated as a fragment of the post-completion evaluation of the environmental impact of the reservoir project in respect to the effects of the microclimate on the historic interior of the church in Dębno, which is located in the immediate vicinity of the Czorsztyn-Niedzica and Sromowce Wyżne reservoirs. The present work involves a characterization of the course of selected meteorological elements – temperature and relative humidity – in the church in

Dębno Podhalańskie in 1996, and thus during the phase of the preliminary filling of the reservoir, and before its official commissioning in July of 1997.

The following research tasks may be regarded as the particular goals of the present work:

1. to plot the course of the daily average values of temperature and relative humidity in the interior of the church, against the background of the outside parameters;
2. to distinguish those periods which show temperature and relative humidity parameters that are particularly unfavorable to the preservation of the historic interior of this church, in terms of the requirements that should be met by places that are considered historic buildings, or in which there are works of art, in view of the physical and chemical processes taking place under the influence of changes in these meteorological elements and those temperature-humidity conditions which are particularly conducive to the growth of fungus and insects that damage wood;
3. to attempt to evaluate the impact of the tested microclimatic elements on the danger to the historic interior of the church.

The church in Dębno, erected on the banks of the Dunajec River, was already in existence in the year 1335. It is not known exactly when the present church was built, but it was probably the latter half of the 15th century. The church is made of larch wood. The great value of this church results in particular from the rich pantone polychrome, the Late Medieval manner of decorating the walls and ceiling, and also elements of the furnishings. Also of great value is the Gothic triptych and the set of sculptures of similar date. The wooden church in Dębno is an historic building, which is endangered by air pollution, and even clean outside air in which there are such natural pollutants as dust, fungus, or bacteria.

In order to preserve historic objects for future generations, the effort should be made to identify the inside air conditions that can be recognized as conducive or essential to the proper conservation of works of art. In order to specify the threat posed to the historic interior of the church in Dębno by an unfavorable configuration of temperature and humidity conditions, a detailed analysis was made on the basis of the existing literature of those values which are conducive to the growth of fungus and wood-destroying insects, and have an impact on museum objects, in terms of the physical and chemical processes taking place there.

According to Krzysik (1978), fungi do not die in the relative humidity range from 20% to 100%, and have optimal conditions for growth at an air temperature between 20 and 30°C. For insects, the optimal conditions for growth, as stated by Dominik (1970), are an air temperature above 25°C and a relative humidity above 75%. As shown by Makowiecki (1985), conditions that are particular unfavorable for museum objects occur at an air temperature above 20°C and a relative humidity above 70%.

On the basis of these three norms, the figures of 20°C for air temperature and a relative humidity of 70% have been assumed in the present study as borderline values, after which there may occur particularly unfavorable hygrothermic conditions inside the historic church in Dębno.

It should be borne in mind, however, that the church was already previously secured against the unfavorable impact of all the threats mentioned above. Thus it was also one of the goals of the present work to isolate those periods when borderline temperature and relative humidity conditions that are particularly dangerous for the historic interior occurred simultaneously. After these values have been exceeded, physical and chemical processes begin that are unfavorable for historic buildings, and optimal conditions are created for the growth of fungus and wood-destroying insects.

The present work also presents a characterization of the course of average daily values of air temperature and relative humidity in the interior of the church against the background of the outside

conditions. The impact of external conditions on the interior was also specified, as was the temperature and humidity autonomy of the church interior. Four methods were used for this purpose:

a) a graphic illustration of the course of the daily temperature and relative humidity parameters inside the church, against the background of the conditions prevailing outside;
b) a comparison of the means, maximums, minimums, and standard deviations of the monthly values of certain meteorological elements inside and outside the church, using a tabular arrangement;
c) a correlation expressing the connection between the daily average values of interior temperature and relative humidity, and the corresponding conditions prevailing outside the church, for each particular month;
d) a graphic depiction expressing the dependency of temperature and humidity inside the church on the values of these elements prevailing outside for particular months.

The outlined issues are presented against a broad background, including a characterization of the issues and problems associated with the site and the building. Thus essential information is also presented pertaining to the physiography of the terrain, the prognoses for changes in the microclimate in the vicinity of the newly built Czorsztyn-Niedzica and Sromowce Wyżne reservoirs and even the entire drainage basin, as well as a characterization of the course of the weather in the test year against the background of the multi-year average parameters.

On the basis of the tests conducted it was ascertained that the temperature conditions inside the church depend to a large extent on the conditions prevailing on the outside. This is indicated by the very high and statistically significant correlation coefficients between the temperatures prevailing outside and inside the building. It was also discovered that the humidity conditions inside the church are largely dependent on the exterior conditions. The corresponding correlation coefficients are also very high and statistically significant. The considerable influence of outside conditions on the conditions prevailing inside point to the very low thermal and humidity autonomy of the church in Dębno Podhalańskie. All the changes that take place as a result of the impact of the Czorsztyn-Niedzica and Sromowce Wyżne reservoirs become visible to a very great extent both outside and inside the church. On the basis of the research conducted it can be stated that for the better part of 1996 the microclimatic conditions did not exceed the accepted threshold values (a one-time occurrence of air temperature above 20°C and relative humidity above 70% did not thus constitute a major threat to the historic interior of the church in Dębno).

The most unfavorable conditions for the interior of the church in the test year, in terms of the temperature and relative humidity, occurred in the summer months of June and August. Only on two days did there occur a simultaneous violation of the threshold values (June 4, August 28). In order to grasp the temporal tendencies of the changes in the microclimate around the Czorsztyn-Niedzica and Sromowce Wyżne reservoirs, and consequently changes in the microclimate inside the church in Dębno, it would be essential to conduct research in subsequent years. It would be advisable to expand the scope to cover such issues as the impact of the synoptic situation on the shaping of particularly unfavorable temperatures, and especially relative humidity, and to research the impact of the presence of people inside the building on the changes in the microclimate inside the church.

References

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