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Saving of Sacral Stained-Glass Window against Moisture Condensation

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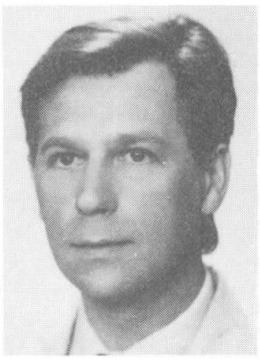

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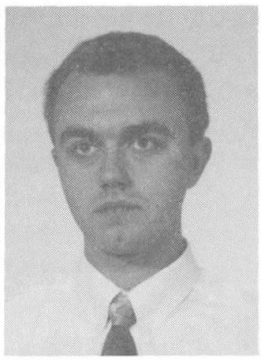

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Summary:

This paper presents the analysis of possibilities of preserving historical stained-glass windows and historical windows from negative effects connected with the condensation of moisture. There were two models examined of this protection with inside and outside ventilation of the cavity between the original and protective glazing. It was proved that using additional window at the outside of the existing one or moving the existing protected window to the inside increases temperature on the protected window. It was found that in the case of the fixed protected window - the first solution - the outside ventilation is more effective. However, in the second solution with the protected window from the inside, the inside ventilation is more effective - the surface condensation does not take place on the protected window.

1. Introduction

The phenomenon of moisture condensation on the inside surfaces of transparent partitions and the problems connected with this issue is not anything new. However, recently the researches relating to this damaging process have been very significant considering the intensity of the inconvenient consequence, particularly in monumental and sacral buildings. The negative effects of that phenomenon are created principally by the influence of the aggressive pollution of the environment; including very polluted atmosphere, particularly in cities, agglomerations and industry regions. The aggressive pollution which is dissolved in the water from rainfall and which exist in the air causes, that the moisture which is condensed on the surface of transparent building partitions has a destructive and aggressive impact. It is confirmed by numerous observations in historical buildings, particularly in shape of destruction and corrosion of window-frames, frosting of windows and stained-glass windows, dump patches mainly under windows and so on.

Because of that a lot of researches relating to moisture condensation on the surfaces of windows and stained-glass windows in historical and sacral building were carried out in Western Europe [1,2,3]. These researches included the recognition of that phenomenon and the description of the ways of protecting windows by using ventilated spaces from the outside or from the inside of the existing partition. The clear choice of the proper way of inside or outside ventilation is not made because there are different opinions on this subject [3,4]. Therefore, for example the outside

ventilation of the cavity between transparent partitions has been chosen in England while in Holland and Germany the inside ventilation appears to be more effective [1].

2. Model of Transparent Partition with Ventilated Spaces

The issue of ventilation of the cavity between two-layer of a transparent building partition can be described as two different models of ventilation. The acceptable models of different are shown on the fig. 1.

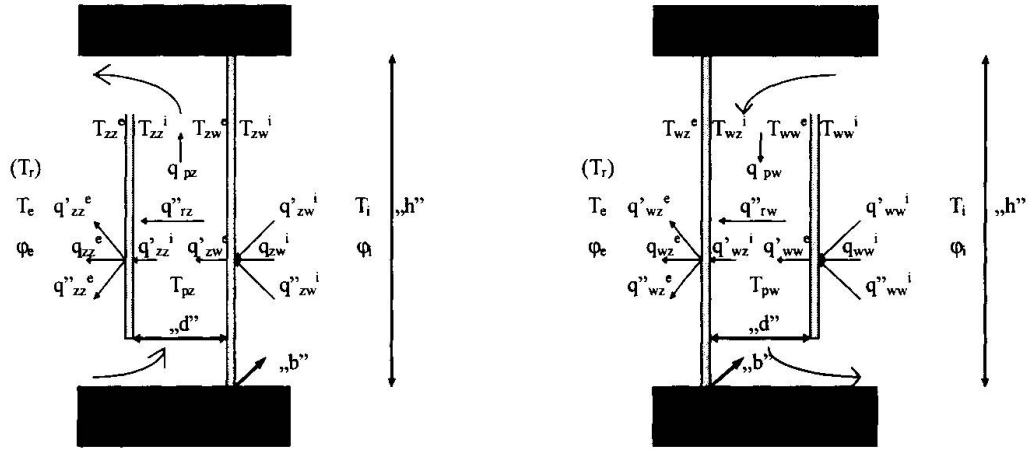

Fig. 1 The transparent two-layer partition with outside and inside ventilation, where:
q, q', q'' - total / convection / radiation heat flux density [W/m^2],
q_{pz}, q_{pw} - heat flux density; the result of warming or cooling the air in the space between layers [W/m^2],
T_i, T_e, T_r - the inside and outside air temperature, environmental radiation temperature [^{0}C],
T - the temperature of surface of the layer [^{0}C],
φ_i, φ_e - inside and outside air humidity [%].

In the situation, in which the protected window is undetachable and the additional window is placed in its inside or outside (the first solution) the outside ventilation is most favourable. In this way the temperature on the surface of the protected window is higher than when the inside ventilation is used; also the dimension of moisture condensation on the protected window is slighter. This fact was confirmed in our own researches [5]. The additional window causes that the temperature on the surface of the protected window is higher. In this way, the surface moisture condensation can be fragmentary reduced.

In the researches made in Western Europe there were applied other approaches (the second solution) to the inside ventilation of the cavity. In this instance of inside ventilation the protected window was moved to the inside and the additional window replaced it [1].

In this case, on the basis of our own researches, it was confirmed that the inside ventilation of the cavity is more favourable than outside ventilation. Though the quantity of condensed moisture is always greater than in the case of outside ventilation, the surface condensation occurs on the additional window and the process of destruction of the protected window is stopped.