Brief Report

on

Research Activities:

Optimisation of Drying Processes for Building Components Damaged by Floodwater, with Attention to Drying Methods for Securing the Building Structure and Avoiding Secondary Damage Arising from Migration of Moisture in Building Components and Inside Residential Premises

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1. Objective of the Research Project

In order to deduce helpful suggestions for the future from previous flood events, and in particular from previously developed remediation concepts, the objective of the research was to compile, organise and assess available experience, with particular attention to detailed study of methods for drying building components damaged by floodwater. Various drying methods were examined in this connection. The aim was to determine the effectiveness of these methods and their potential application areas and limitations, and to the extent possible to assess them on the basis of calculations performed by the researcher.

2. Execution of the Research

The first activity was to conduct a comprehensive study of the literature in order to determine which documents and/or studies on the subject were already available. In addition to various brochures, articles in specialist magazines and reports of symposia on flooding, dissertations dealing with this subject were evaluated.

Following the literature study, studies of a wide variety of building components were carried out by using the WUFI program of the Fraunhofer Institute for Building Physics to perform extensive simulations of the hygrothermic drying behaviour of typical building components.

To enable assessment of the influence of ambient conditions on the drying behaviour of building components, a variety of ambient conditions (indoor and outdoor) were used. In particular, this involved investigating the influence of condensation ventilators and infrared heating panels, drying starting at different times of the year, and the influence of outdoor temperature.

3. Summary of the Results

Floods repeatedly cause major damage. In particular, floods covering large parts of eastern Germany in August 2002, as well as in Austria and the Czech Republic, caused damage on an unprecedented scale. Due to global warming, it must be expected that such events will occur more frequently in the future.

There is often considerable uncertainty regarding how to deal with flood damage, and there is a lack of knowledge regarding which remediation measures are worthwhile for correcting such damage. Flood victims find themselves in a situation of acute need immediately after the event, and this combined with the desire to return to ‘everyday life’ as quickly as possible creates favourable conditions for profiteers.

The first thing to be determined was how much moisture the building components could absorb during a flood. Here it was assumed that the cellar was fully flooded and the ground floor was under water up to 50 cm above the floor level. The calculated amount of absorbed moisture was approximately 18 m^3 for a sample house with aerated concrete walls and approximately 9 m^3 with sand–lime brick walls. The additional consumption of heating oil for drying amounted to approximately 1295 litres for moisture evaporation with aerated concrete masonry and approximately 658 litres with sand–lime masonry.

Additional calculations were performed to determine whether in the case of the previously examined rooms the resulting moisture volumes could be removed by natural room ventilation. The results show that this would require an air exchange rate of 2 to 6 times per hour. According to information in the literature, significantly higher air exchange rates can be achieved with fully opened windows. It is thus possible to dehumidify rooms on the ground floor by natural ventilation. With regard to cellar rooms, it is not possible to draw any conclusions regarding whether window ventilation would be sufficient because cellar windows often face onto light shafts, with the result that unobstructed air exchange cannot occur.

The time of year when the flood occurs has little effect on the course of the drying process, and the associated differences in the temperatures of the building components have little effect on the drying behaviour of building components damaged by floodwater. The drying time of the building components examined in this study remained the same in most cases. A longer drying time to the point where a practical moisture content for external plaster was achieved was only seen in the simulations for drying starting in October and November.

The results show that drying of building components damaged by floodwater is accompanied by a considerable expenditure of time and energy. If it is desired to expel the moisture from the building components quickly, powerful drying equipment must be used and large amounts of energy must be expended. Heat must be transferred to the building components to accelerate the drying process. Various types of drying equipment are available for this purpose. The necessary length of use of the drying equipment differs from one building component to the next, and each case must be examined individually in order to avoid damage due to excessively fast moisture loss.

Especially in the initial stage, the drying process can be accelerated considerably by using infrared heating panels. The moisture content of the investigated aerated concrete and sand–lime brick masonry changed only slightly during the first days without infrared heating panels, but a large decrease in the average moisture content of the material could be seen when infrared heating panels were used.

In conclusion, based on the analyses it can be confirmed that infrared heating panels can considerably accelerate the drying process in building components.

Consequently, it is recommended to use infrared heating panels for several days during initial drying in order to accelerate the drying process. However, further drying by means of intensive room ventilation or the use of air dehumidifiers is always necessary.