

Monitoring of Air Infiltration in Museums, Case study: The National Museum of fine Arts, Stockholm, Sweden.

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Abstract

Most Museums of Fine Arts try to control the quality of the indoor air for several reasons. One important issue is to keep the room air temperature and relative air humidity stable, thus avoiding fluctuations of Moisture Content in organic material.

Air exchange of outdoor air with the indoor air in a museum building can be divided into two classifications, ventilation by the ventilation system and ventilation by infiltration. The ventilation system can be natural or forced. Forced ventilation is also called mechanical ventilation. Infiltration is one of the uncontrolled flow of outdoor air into the building through cracks and other unintentional openings and through the normal use of exterior doors for entrance and egress. Infiltration is also known as air leakage into a building.

To be able to fully control the indoor air quality in a building it is essential to know all air flows into the building. The mechanical ventilation system has to compensate for the infiltration.

The air exchange rate compares airflow to building or room volume. The unit is 1/time and normally the time is hours, why we talk about air change per hour, ACH. The only reliable way to determine the ACH of an existing building is to measure it by tracer gas technique.

Several tracer gas measurement procedures exist, all of them involving an inert or none reactive gas used to label the indoor air. All tracer gas measurement techniques are based on a mass balance of the tracer gas within the building. Normally it is assumed that the outdoor concentration is zero and the indoor air is well mixed.

This paper describes tracer gas measurements at the National Museum of Fine Arts in Stockholm. The building was erected 1850-1860 and the architect was Friedrich August Stüler. He created several museums of Fine Arts, among them Neues Museum in Berlin. The museum building in Stockholm has a volume of almost 90 000 m³ and the number of registered objects of art is well over 600 000. The collection includes one of the world's most prestigious collection of drawings and graphical prints.

In this case study the aim was to determine the infiltration through the main entrance and stairwell, through windows and outside walls. The measurement technique used was the Homogeneous Emission Technique added with a 2-zones set up, by using two different tracer gases.

Several interesting results were obtained. One result was that more airtight entrance doors would decrease the infiltration into the main stairwell with 40 %. Another result of interest was that the very dry outdoor air was mixed with the indoor air quickly, and that the mechanical ventilation system with filters and humidifying units have to be upgraded to compensate for the outdoor air.