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APPLICATION OF COMPUTATIONAL FLUID DYNAMICS (CFD) MODELS FOR RISK ASSESSMENT AND MITIGATION OF INDOOR CLIMATES IN HISTORICAL BUILDINGS

Goran Simeunovic[a], Tomas Vyhlidal[a], and Pavel Zitek[a]

[a] *Department of Instrumental and Control Engineering, CTU in Prague, Czech Republic, email goran.simeunovic@fs.cvut.cz*

ABSTRACT: In this talk, the numerical computational fluid dynamics (CFD) models of the Holy Cross chapel in Karlstejn castle and the Bed chamber in Linderhof castle will be presented. These complex three dimensional CFD models were primarily developed to analyze and study the impact of variability of the outdoor conditions and the impact of visitors on distribution of relative humidity in the air volume of the interiors. Thus, using the models, simulated data of future climate conditions were projected to the indoor-climate conditions, revealing the potential risks associated with the climate change. Next, the models were used to test and optimize control systems for reducing the relative humidity in the interiors. For the Karlstejn Castle, the current intensive airflow based control system was modelled, revealing the risky zones particularly in window alcoves. For the interior of the Bed chamber in Linderhof castle, the concept of the ventilation system utilizing the forced ventilation through the fireplace chimney was tested. The numerical investigation of the air circulation and moisture movement in the interiors were modeled by the governing equation of fluid dynamics including the Reynolds-Averaged Navier Stokes (RANS) equations within appropriate boundary conditions. The turbulent $k-\varepsilon$ is used in this consideration. The obtained results were verified on the basis of the measured data during the annual measurement campaign. The achieved results with enough accuracy fit the measured data. These results show the zones in the both castle with the worst preservation conditions. These problems can be solved with appropriate placement of the air-conditioning unit and choosing the appropriate control algorithm of this unit.