Supply Air Parameters Interaction on Thermal Performance of IEAC

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I. Introduction

In an indirect evaporative air cooling (IEAC) installation air is cooled by means of adiabatic humidification process. By passing over an air/air heat exchanger this air cools the supply or mixed (supply and extracted) air. A clear interaction can be observed between the relative humidity and temperature of the supply air and the thermal comfort implemented in the building. To be able to predict the performances of this technique well, a good knowledge of the supply air relative humidity and temperature are thus important. Paper presents the results of measurements carried out in summers of 2008, 2009 and 2010 in a simulated nonresidential building in 3 cities of Latvia: Riga, Liepaja and Gulbene which make indirect evaporative cooling usable. An evaluation of the indoor summer comfort is made and the interaction between the thermal performance and outdoor air parameters (humidity and temperature) are investigated.

Work actuality is based on the Latvian Cabinet of Ministers regulation No. 534 Regulations Regarding Latvian Building Code LBN 231-03 "Residential and public buildings heating and ventilation" 118th paragraph, "If the air handling equipment for air cooling assess whether the compression cycle cooling techniques can't be replaced by a direct or indirect adiabatic cooling techniques to minimize the impact on the environment." Topic view and updating gives more understandable operating positive and negative aspects, which in turn give engineers new viewpoint to the evaporative cooling as the primary cooling type of General Regulations

II. Calculated and Measured Model

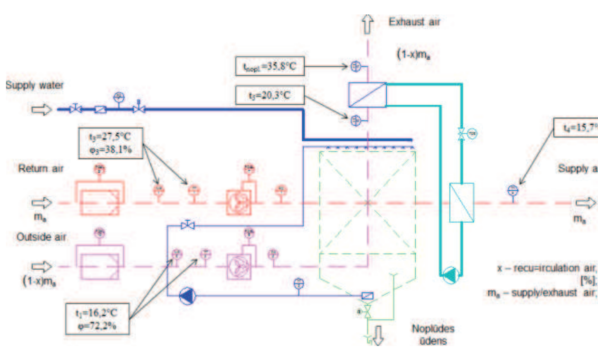

Fig. 1. Practical and calculated model of studied device

Place To validate the model; experiments were carried out in an air handling unit with indirect evaporative cooling which is installed to provide cool air in non-residential building in Essen, Germany. The installation for building was in operation since September 2010 and was dimensioned to a maximum air flow rate of 6,000m³/h. [2] Indirect evaporative cooling is operating around-the-clock The air handling unit consists of a polypropylene double cross flow heat exchanger with dimensions 1250mm x 1215mm x 997mm. The total heat exchange surface was approximately 300m² which results in an air flow rate of about 20m³/h per m² heat exchange surface.

All results are obtained by using measurement devices as shown in Figure 1 (TT- bulb, MR – relative humidity measurement device, etc.). At the return air side the air is ventilated between parallel plates while at the supply side distance holders are introduced in order to ensure stability of the parallel plates. The distance between the plates is approximately 5.1mm. [3] Both the supply and return fans are supplied with frequency control and their air flow rates are balanced. Water sprayers are placed at the top of the first part of the heat exchanger. The water is collected in a sump below and recirculated. Approximately every hour the system is replenished with fresh water to avoid problems e.g. with bacteria.

III. Conclusions

Calculations of feasibility index values in 3 cities of Latvia have been calculated. Data shows that difference 11°C between dry-bulb temperature and wet-bulb temperature is needed.

1D numerical model of counter-flow wet surface heat exchanger was developed based on the heat and mass balance of the supply and return air. Using a control volume method the outlet conditions of both supply and exhaust air can be calculated. The model assumes that the heat transfer resistance of both water film and plate are negligible and that the water film is stationary and continuously replenished with water. The model has been validated using measured data in a double cross-flow heat exchanger. The installation has been modeled assuming evaporation only takes place in the first part of the heat exchanger. The second and dry part of the heat exchanger was modeled using e – NTU correlation and linked behind the wet surface heat exchanger model in MS Excel. The supply air temperature and the return air temperature just behind the first part of the heat exchanger were in good agreement with the measured data. The model underestimated the temperature of the exhaust air because it does not take into account the fact that the return air is heated by the recirculated water in the second part of the heat exchanger.

V. References

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