Master's Thesis Defense Announcement
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THERMAL DESTRATIFICATION OF AIR STREAMS TO IMPROVE THE COOLING PROVISIONING OF AIR-COOLED DATA CENTERS

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Abstract

According to ASHRAE, Air side economization is an arrangement of duct, damper and automatic control system which together allow introducing outside air to reduce the mechanical cooling during mild or cold weather thereby decrease the energy consumption. The outside ambient air and heated return air from the information technology (IT) pod is mixed inside a dedicated space to achieve a target cold aisle operating temperature and thereby increase economization. The dedicated space where these two air streams mix is called a mixing chamber. Major constrain faced by the design engineers while designing the Mixing Chamber/ Plenum is the stratification of air stream due to the Temperature gradient in the mixed air stream and this stratification can be attributed to the short span of time and space that is available for the air streams to interact with each other. Thermal stratification can lead to coil freeze-ups, nuisance freeze-stat trips, energy wastage due to sensing error and poor indoor air quality. Thermal Stratification also increases the cooling power needed by over provisioning. In this study mixing chamber configurations are considered upon surveying the commercially available modular cooling units with mixing chamber/plenum built into them. So, to achieve our objective we want to understand the fundamental physical phenomenon which causes mixing of any two fluids and thereby apply the knowledge to our test scenario. Literature review gave us the information about Richardson number a dimensionless number which is a ratio between buoyancy and flow shear stress and for improving the process of mixing the Richardson number should be minimized. The variables involved in minimizing the Richardson number are the velocity and temperature difference between the two fluid and the total vertical column height of the two fluid that needs to be mixed. This fundamental understanding will help us in determining the structural features needs to be achieve the desired mixing. The scope of the project is also extended to address the effect of thermal stratification after evaporative media cooling pad, in this scenario the process of segmentation of the pad for reducing the relative humidity also creates thermal stratification. CFD analysis is carried out to report the proof of concept and thereby report the changes in the effectiveness of the mixing process at upstream of heating coil and downstream of cooling pad.