2017

Anthem Sustainability Project

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CAPSTONE DESIGN EXPO 2017

Problem Statement

The goal of the Anthem Sustainability Project is to capture waste heat from a 2.5MW data center and recycle it for domestic heating.

Current Data Center Cooling

Anthem's data center uses an air-cooled system (Figure 3). Cold air is supplied through the floor across the face of server cabinets. Cabinet components emit warm exhaust (90°F) which makes its way to the ceiling plenum through either induction, hot-aisle containment, or cabinet chimneys. Computer room air handling (CRAH) units located along the perimeter remove heat from the air using a cold-water coil and re-supply it to the underfloor plenum. CRAH unit water goes through a chiller cycle (Figure 1) where heat is transferred to a condenser water loop. Ultimately server exhaust heat is deposited to the atmosphere through cooling towers.

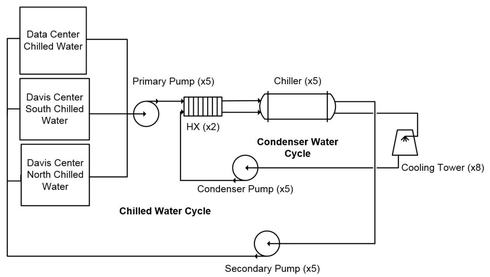


Figure 1: Simplified diagram of current chilled water cycle used for heat removal

Solution: "Air Dumping"

The Air Dump thermal recycle method directly supplies warm air from the data center ceiling plenum to a conditioned space. In this case, the main entrance lobby (Figure 3). Using a fan powered terminal box, air is removed at a controlled rate and supplied through the floor to be diffused into the main lobby.

In order to maintain the data center's pressurized air balance, an equivalent amount of air must replace the air dump supply. Make-up air is added to the data center through a series of single-duct boxes supplied by the make-up air shaft.

Air Dumping is preferred because of its air-to-air nature, retrofit-ability, and potential for expansion to other conditioned spaces.

Figure 2: SolidWorks render of Anthem lobby and data center

Air Dumping Essentials: Thermal Containment

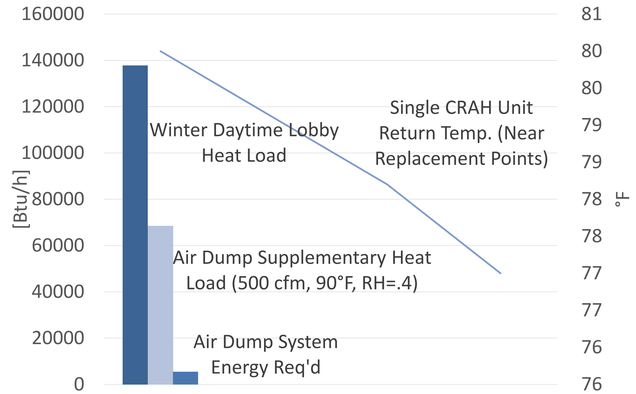
Thermal containment is an important factor in keeping the ceiling plenum air as hot as possible as well as reducing cooling load supplied to all cabinets. This can be accomplished through the use of hot aisle cabinet orientation, isolated hot aisles, and cabinet chimneys directly linked to the ceiling plenum. 90°F is the target goal for ceiling plenum return temperature.

Point of Interest	Description	Air Psychrometric Properties	Notes
1	Server Cool Air Supply	60° F	
2	Server Exhaust	90° F	Varies with equip. load, req's extensive temperature containment
3	Air Dump Extraction (Supply) Point	90° F, 40% RH, h=22.5 Btu/lb	Located above hot aisle or racks w/ chimneys, 1000-2000 cfm to Lobby underfloor chase(97,416-194,832 Btu/h), Lobby chase SP setpoint: 1.5" wc
4	Air Dump Replacement Point	50-65° F, 40% RH	Located near CRAH unit to prevent mixing with extraction stream, Must equal extraction rate, Ceiling plenum SP setpoint: .8" wc
5	CRAH Unit Return	77° F, 40% RH	Return temps will increase with temperature containment effort

Figure 3: Proposed Air Dump data center cooled-air loop

Impact

Every Btu/h that is dumped into the lobby is money saved. A supply rate of 1000-2000 cfm will replace 7-15% of the total lobby heat load. Removing 80-90°F heat from the data center while simultaneously replacing it with 50-65°F make-up air will lower CRAH unit return temperatures resulting in a decreased chiller plant load.



Future Considerations: Thermo-electric Modules (TEMs)

Building spaces require warm air less than 6 months out of the year. To take advantage of waste heat during the warmer months, thermo-electric power generation can be considered. TEMs produce electricity as a result of a temperature difference between two nodes. Current TEMs can operate with as little as 18°F temperature difference, however, produce too little voltage to justify installation.

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