Q&A: Dehumidification In Schools

In April, Tom Durkin hosted an extremely popular *ES* webinar tackling humidity in schools. We ran out of time and had a slew of leftover questions, so here, his engineering team joins him in addressing them. Caveat: The questions often solicit professional opinions based on experience, but that candid exchange is part of the beauty of the webinar, right?

BY THOMAS H. DURKIN, P.E., KEITH CECIL, P.E., JOHN PRUETT, P.E., STEVE ROOKE, P.E., AND CAMERON YAMASHITA

1. Question: You started by saying that high summer humidity was the number one IAQ issue. What about lack of fresh air?
Response: As a firm, we have investigated over 50 IAQ problems in buildings. We have found nearly all calls to be a result of high indoor humidity levels, not due to a lack of fresh air. Invariably, once we were on site doing our IAQ testing, we also often found elevated CO_2 levels indicating low ventilation rates.

2. Question: Are parts of the country more to humidity problems than others?
Response: Any area east of the Rockies or the Pacific Northwest is most likely to be susceptible to high humidity problems.

3. Question: How do you balance humidity control and energy efficiency?
Response: This is the single biggest issue facing the engineer trying to control humidity. The prerequisites for acceptable design are IAQ, humidity control, and occupant comfort. Only after those items are thoroughly addressed, should energy efficiency be considered.

4. Question: What's your opinion on varying chilled water supply temp to aid humidity control?
Response: The lowest chilled water temperature is needed when the building has the greatest demand for dehumidification. If your motivation for varying chilled water supply temperature is to save energy by delivering higher chilled water temperature, it's important to remember not to compromise humidity control for the sake of operating costs.

More Where These Came From

We answered many more questions from viewers during the actual "Humidity Control in School Buildings" webinar, sponsored by Munters and Nortec. To watch a recording of the entire one-hour event, including the main presentation and subsequent Q&A, go to *http://webinars.esmagazine.com*, complete the free registration, and enjoy.

5. Question: If the weather conditions permit, why not use the HVAC system in full economizer to dry the carpet?
Response: If weather conditions permit (outdoor air wetbulb temperatures under 50°F), this might be a good idea. However, during the summer carpet cleaning, when the outside air humidity levels are at their highest, this option would not be advisable.

6. Question: We are looking to do demand shaving by resetting the send-out central chiller plant for an event that may occur for 6 hrs, 10 times during the cooling season. Any thoughts on mold control?
Response: Refer to chart presented in the webinar. [The chart shows that as long as the duration of high humidity is not significant, mold growth is less likely because mold occurs with protracted exposure to high rh.] We recommend staying well below the marginal area on the chart.

7. Question: My building only has a mold issue at the first register out of a rooftop unit. It is an office building. Would this suggest that it is most likely a condensate carryover issue? What might be some likely causes? I'm thinking improper cleaning, but what may be others? We have done a mold study, and only this area currently is showing mold. I have two proposals on the table — hot gas bypass and a DOAS for this plus five other RTUs. I am wondering if it is an equipment issue or a building issue and how to proceed. I'm planning a summertime study of humidity with dataloggers.
Response: We would check the unit to ensure no outside air is bypassing the filters. However, there may potentially be other sources of high latent air causing this problem. High outside air concentrations could be coming in via an adjacent vestibule introducing outside air near this diffuser, or via envelope leakage, resulting in the condensation and subsequent mold. We would not rule out other issues outside of the ductwork and rooftop unit

8. Question: Do you design reheat systems for school A/C systems?
Response: If there is adequate justification for it. However, if we elect to use reheat for humidity control, we advocate the use of a heat recovery chiller so that we reheat without "new" energy.

9. Question: What are your thoughts on the use of heat pipes and runaround coils?
Response: It depends upon the application. Heat recovered from a heat pipe to be used at an AHU may make sense in some applications. However, it is impractical to use the recovered heat at terminal units. Runaround coils are typically inefficient and require exacting economic analysis to verify their cost-effectiveness. A large disadvantage of both of these applications used for reheat is that the greatest need for reheat often occurs at low load, when there isn't much energy available for them to recover.

10. Question: With today's energy costs, who will design a 24-hr operation?
Response: It's not a question of who will design it, but if it inadvertently happens. If the building HVAC occupancy is not correctly scheduled, or if someone thinks that humidity problems will be better helped by allowing the equipment to run constantly, there will most likely be humidity problems as a result.

11. Question: What manufacturers have you found to be most effective for DHRC applications?
Response: The right DHRC equipment is any water cooled chiller that can make 130° condenser water and has the control capability to seamlessly switch between evaporator and condenser control.

12. Question: For museum applications that require tight temperature and humidity control, what is the best system?
Response: It is best to follow the guidelines outlined in the *ASHRAE Handbook — Applications*. However, we recommend that it is most efficient to ensure that any reheat required comes from recovered heat.

13. Question: Any comment on reliability and accuracy of CO_2 and humidity sensors?
Response: We try to limit the application of CO_2 sensors to large spaces such as auditoriums, gymnasiums, and cafeterias so that their use is minimized and the maintenance burden (e.g., calibration) on the owner is kept to a minimum. Humidity sensors, when needed, are used to monitor several clustered areas with similar characteristics to minimize their use.

14. Question: In your opinion, what are the acceptable limits for temperature and humidity during unoccupied periods with the systems disabled?
Response: We would start by looking at the wetbulb temperature in lieu of using a specific temperature or humidity level. Any resulting temperature and relative humidity with a wetbulb temperature below 59° would be a good choice.

15. Question: You mentioned having a summertime humidity analysis; what is included in this?
Response: A thorough humidity analysis is needed when selecting equipment for dehumidification. Multiple temperature and humidity conditions for outside air should be considered in equipment selection. The equipment shall not just be evaluated at peak cooling and heating loads, but also at part-load conditions with high humidity such as 70° and high humidity often found on rainy days with partial building occupancy.

16. Question: Regarding DOAS, any thoughts on final discharge temperature, i.e., neutral to space usually requiring reheat or lower?
Response: It depends upon the connection and arrangement of the DOAS system. If DOAS air is supplied directly to the space, we would likely make the DOAS temperature room neutral. However, if the DOAS air is supplied in conjunction with a terminal unit such as two-pipe system, we recommend it be supplied to deliver warm air during cooling season and cool air during the heating season to address the concurrent heating and cooling demands of the space.

17. Question: What about duty cycling the central air handler fans every 15 min for a peak shaving event? Would this wet and dry the cooling coil too much?
Response: We do not advocate any strategies that would compromise IAQ, occupant comfort, or humidity control. However, if the realities of the situation are such that duty cycling is an option, cycling off the AHU fan would probably compromise these. Closing the outside air damper would only compromise the IAQ. Duty cycling of the air handler should be avoided, but potentially cycling the OA might be a better strategy if used in conjunction with CO_2 monitoring.

18. Question: Is mold growth more a function of dewpoint or rh?
Response: Mold growth is a function of rh.

19. Question: What is the impact on the humidity levels when there is a significant breech in the building's vapor barrier?
Response: It depends upon the size of the breech, but if there is a significant breech, then in order to maintain positive building pressure to prevent infiltration, the outside air quantity would need to be significantly increased. An operating strategy would be required to be devised to keep the building at positive pressure during unoccupied times.

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20. Question: Of the four systems — DOAS, reheat, VAV, and face and bypass — which is least expensive to install and operate over 20-yr duration for a central Missouri location?

Response: In our opinion, the least expensive system to operate and install for most climate zones would be a two-pipe face and bypass system. All of our studies and experience show us that it is the least expensive to install and operate when properly designed and controlled.

21. Question: Do you have a recommended minimum OA quantity for systems when using CO_2 control for OA flow variation?

Response: We advocate following ASHRAE Standard 62 when choosing the OA quantity for a system with CO_2 control for outside airflow variation.

22. Question: What do you consider the optimal range for CO_2 for student learning?

Response: We recommend at least 700 ppm above ambient as recommended by ASHRAE Standard 62. Ambient CO_2 levels are usually in the 300 to 500 ppm range, but in urban environments it might be higher.

23. Question: When we reduce the fan airflow, what will happen to fresh air?

Response: We would program the air-handling equipment so that when it does change fan speeds, the outside air damper increases position to maintain the minimum outside air quantities as listed in ASHRAE Standard 62. **ES**

From left, Yamashita, Pruett, Durkin, Cecil, and Rooke, are with Durkin & Villalta Partners Engineering (Indianapolis, IN).