Chilled-Water VAV System Configuration and Design

I found February's "Air-Cooled Chillers: Chilled-Water VAV System Configuration and Design" by Nabil Nassif, Ph.D., P.E., Member ASHRAE, interesting because it reminded me of a design I would occasionally come across in my early days in the HVAC industry in New York City some 50-plus years ago.

The design was a combination heating-cooling coil in air-handling units, usually in office buildings. Of course properly zoned two-pipe (or three-pipe) secondary fan coil systems were more common for the perimeter of office buildings (the premier design being four-pipe fan coils). With the advent of VAV, it became a more cost-effective option, especially with the reduction in percent glazing of a building, replacing perimeter fan coils.

I have some questions and points about other design bases indicated from the February article.

1. Why are proposed Option 1 and Option 3 limited to an air-cooled chiller plant? Why not apply them to a water-cooled chiller plant?

2. The cooling and heating plant consists of two 500 ton chillers and two 5 MBtu/h boilers. The article did not state if this is an $N+1$ design. Or is each chiller size for 50% of the building cooling load and each boiler size for 65%/75% of the building heating load? The difference is the implied size of the building with an $N+1$ design, implying a smaller building. And perhaps that's why the author specified this design for an air-cooled chiller plant.

3. The hot water circulating temperatures shown seems to preclude specifying condensing boilers. The higher temperatures shown in an AHU coil would be warranted in a winter climate similar to New York and other northeast states.

4. In terms of control valve location at the coil, one finds varying opinions. Some prefer the chilled water control valve on the return side, i.e., outlet side, and the hot water control valve on the supply,

i.e., inlet side of the coil. Some would prefer both control valves on the return side. Some prefer the control valves on the supply side for both chilled water and hot water.

I noted the author did not get into the details of piping at the central equipment and at the coils, as is evident from the diagrams.

Another point to be raised, which does have to do with the piping at the coils, is that chilled water cooling coils are piped in a counterflow configuration for maximum heat transfer, and heating coils are to be piped in a parallel flow configuration for maximum heat transfer and coil freeze protection. This requirement will add to the piping at the combination cooling-heating coil.

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The Author Responds

Thank you for your interest. The option of using both coils in an AHU for cooling during summer, or the option of using a single coil for cooling or heating as needed in an AHU, can provide cost-effective solutions for existing and new HVAC systems. It can offer new methods to integrate heat pumps in VAV systems, leading to decarbonization and electrification of our future buildings.

Yes, the methods can be applied for water-cooled chiller plants as well. You can read advanced configurations tailored specifically for water-cooled chillers in this issue starting on page 12.

In the February article, I give an example of two air-cooled chillers and condensing boilers with specific sizes. The numbers are presented as an example and are intended just to give estimations for the cost savings that may obtained from the proposed four design and control options.

More data and analysis with various building and equipment sizes will be a subject for future work.

Option 3 and Option 4 will be implemented and deployed in real HVAC systems installed in the HVAC lab at the University of Cincinnati. Control valve locations and coil configurations are important points that could be addressed in future studies.

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