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ENGINEERING

SYSTEM SOLUTIONS

In this issue, we begin with a discussion of the benefits of vertical self-contained HVAC systems and a straightforward approach to achieving a quiet environment in occupied spaces when using these indoor systems.

We have also included an update on the results of the ASHRAE annual meeting held in Minneapolis in June 2000.

You can find this and other issues of Engineering System Solutions on our website at www.mcquay.com. Also, check out our "What's New" page for information and literature on McQuay Vertical Self-Contained systems and other McQuay products.

McQuay provides semi-custom system solutions for commercial HVAC applications. This newsletter is written specifically for the HVAC engineering community. We welcome your comments, feedback, and article suggestions.

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Director of Sales
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The Vertical Self-Contained HVAC System Approach

Benefits and Design Tips

What is a vertical self-contained unit?
A vertical self-contained unit is an indoor air conditioner with DX refrigeration that is typically water-cooled. They are compact, with VAV or constant volume operation, and come complete with advanced controls.

Examples of applications include office buildings, schools, libraries, museums, auditoriums, manufacturing facilities, hospitals, retail, and banks. A unit is selected to serve the space or floor on which it is located.

What are the benefits of vertical self-contained units?
There are many reasons vertical self-contained systems are popular. From a project management perspective, the units can be delivered as the floors are built rather than at the start of the job (as is the case with a basement mechanical room) or the finish (as with a rooftop penthouse). In fact, the unit is not required until there is a tenant for the space as long as accommodations are made for the equipment to be delivered after the curtain wall is in place.

The distributed approach and product flexibility of self-contained systems allows easy tailoring to meet tenant and owner needs. It is not a problem to have general office space on one floor and an IT tenant on the next, nor is it difficult to accurately allocate utility expenses to each.

The distributed approach also keeps the air conditioning unit close to the area it serves, lowering the fan horsepower requirement and eliminating the need for return fans. In contrast, as the number of building stories increases, roof mounted HVAC systems require more and more fan horsepower and larger shafts to move the supply and return air to the occupied space.

The ducting design for each unit (typically VAV) is a straightforward low pressure design in which the ceiling is used as a return plenum. Overhead heating to offset skin loss is accomplished either with perimeter reheat boxes or fan assisted boxes.

Heat rejected by the self-contained units is carried to a roof mounted cooling

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tower. The piping and pumps required to move this rejected heat require less space than the supply and return air shafts of an all air system, and generally cost less to install and operate.

Outdoor air is delivered through a shaft to the mechanical room of each unit by use of a dedicated make-up air unit. The correct amount of outdoor air is then assured by balancing the make-up air system. Because the fresh air volume operates independently, it is not susceptible to modulating supply air volumes. Heat recovery is easily accomplished by using the condenser water loop in the make-up air system.

Self-contained units offer both air- and waterside economizers. The waterside economizer can operate simultaneously with mechanical cooling, extending the useful free cooling season. Compared to airside free cooling, the waterside approach reduces the size of the air shafts and eliminates the need for extra exhaust air fan motors and smoke dampers.

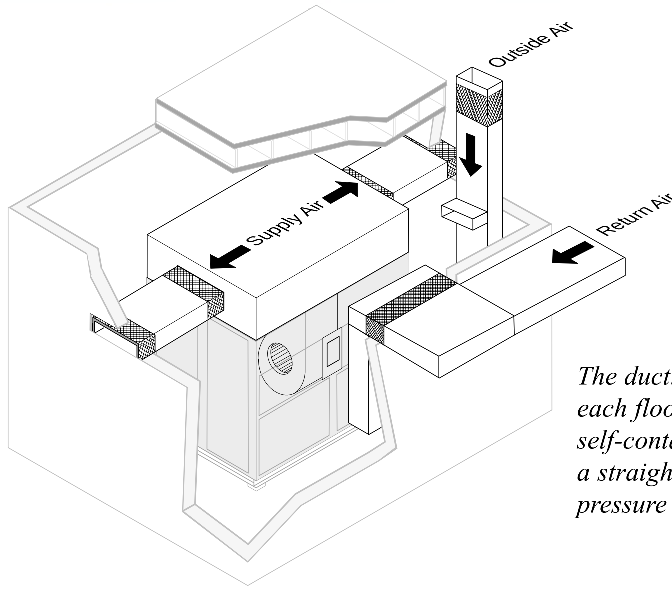
Self-contained system efficiencies are achieved by combining the waterside economizer with multiple scroll compressors and large heat transfer surfaces. This can provide excellent overall system efficiencies that are comparable to most HVAC system alternatives, at installed costs that can be significantly less.

If a service issue arises, the distribution of the self-contained units isolates the affected area. The use of multiple compressors provides redundancy at the unit level, allowing the unit to function at part load until repairs can be made.

Maintenance of self-contained units is easily accomplished because they are located in a mechanical room. Access to the ceiling plenum or the roof is not required. Since self-contained systems use multiple 6 to 20 hp scroll compressors, their DX refrigeration systems can be serviced by a wide range of service mechanics.

Acoustics

Self-contained units are designed to be exceptionally quiet because they reside near the occupied space. While some care must be taken in addressing acoustics, the units routinely meet NC-37 in the occupied space without elaborate acoustic treatments.



The ducting design for each floor of a vertical self-contained system is a straightforward low pressure design.

Develop an acoustic solution

Specifying NC-37 without having an acoustic solution is like specifying 75ºF occupied temperature without knowing the cooling load. It requires those who quote the project to make assumptions that may not be realistic, which can lead to problems down the road.

A typical building has only a few different floor designs; the first floor, the middle floors and the top floor. It may only be necessary to work out the appropriate acoustic solution for the floor with the highest sound power level.

Start with reliable sound power data

Not all units are alike. Sound power allows the engineer to make a clear comparison of the sound performance of different equipment. It is also the starting place for working out the NC level in the occupied space.

It is not necessary to design the project to attenuate the equipment with the highest sound power levels. In fact, using the lower sound power levels is better in terms of both first cost and operating cost. Specify the equipment sound power levels that work with the acoustic treatments used to meet the design sound level. By doing this, the plans and specifications will include an acoustic solution. If equipment with higher sound levels is proposed, it is a straightforward matter to improve the acoustic treatments to meet the desired sound level.

Applied versus custom equipment

Sound performance can be estimated from fan test data, which is based on ideal conditions. Correction factors are then used to estimate the actual acoustic performance of the unit. Every project is different and, while custom equipment offers excellent unit flexibility, oftentimes the unit sound data is not available. As a result, a sound test with a mock unit is required which can put an unnecessary financial burden on the project. If a sound test is not performed, then the acoustic solution becomes guesswork.

Applied equipment offers almost as much flexibility as a custom unit. However, applied units offer the added advantage that the sound data is based on the tested unit.

Watch the lower octave bands

Generally speaking, if the first and second octave bands (63 and 125 hz) are good, the project will be quiet. Special care should taken to minimize low frequency noise since it is more difficult to attenuate. For example a 63 hz sound wave is 18 ft long as compared to a 500 hz sound wave at 2.2 ft.

How to address noise

By concentrating on four areas, an acoustic solution can be found to meet the needs of any project.

1) **The design of the self-contained unit itself.**

   As mentioned earlier, not all units are created equal. Use sound power to assess the equipment and pay special attention to the 63 and 125 hz bands.

2) **The size, location and construction of the Mechanical Equipment Room (MER).**

   This requires working closely with the architect on the details of the MER. The acoustic solution may be as simple as changing from standard block to acoustic block in the MER walls.

3) **The design of the supply and return ducts.**

   As with any HVAC system, duct design is critical for thermal and acoustic comfort.

4) **Design of tenant occupied spaces.**

   How the tenants use the space will directly affect sound levels. For instance, carpeting is much quieter than tile flooring. In general, keep sensitive areas away from the main duct runs and MERs.

Conclusions

The self-contained system approach is straightforward and offers an excellent solution for medium size, multi-story office buildings and a multitude of other applications. It involves a multiple unit VAV design (with repeating floors that reduce design time), a condenser water loop and a constant volume make-up air unit. Some care must be taken in addressing acoustics, but this too can be straightforward when approached as part of an overall acoustic solution.

For further information on self-contained system design and acoustics, contact your local McQuay Representative.

Added Benefits of McQuay Vertical Self-Contained Systems

- **Semi-custom flexibility** allows specifiers to design systems without compromise.
- **Quality construction** promotes longevity, low sound and operating efficiency.
- **Factory-installed controls and a full factory run test** to ensure reliable startup and reduce installation costs.
- **Exceptionally low sound levels** verified in independent laboratory tests.
- **VAV operation and low discharge air temperature capability** reduces the design air volume (CFM), motor horsepower requirement and duct size, resulting in lower installed costs and quieter operation.
- **Compartmentalized design** places major DX system components out of the supply air stream, allowing maintenance and service while the unit is operational.
- **Knockdown design** allows units to be split into sections to negotiate hallways, elevators, and doorways and reassembled without brazing, evacuating or charging the system with refrigerant.

ASHRAE Annual Meeting Summary

ASHRAE met in Minneapolis in June for the annual meeting. Here are some highlights:

STANDARD 15 – Safety Requirements for Mechanical Rooms

This standard is on continuous maintenance. The requirement for self-contained breathing apparatus (SCBA) was deleted.

STANDARD 34 – Safety Classification of Refrigerants

This standard is on continuous maintenance. R-245fa was classified as a B1 refrigerant.

STANDARD 62.1 1999 – Ventilation Requirements for Acceptable Indoor Air Quality

This standard is on continuous maintenance. Four more addenda were approved for public review. Currently there are 25 addenda ready for public review. Several are out right now. Addendum n, which is not out yet, is generating a lot of discussion as it pertains to ventilation rates.

STANDARD 90.1 1999 – Energy Efficiency in High Rise Buildings

This standard has replaced the 1989 standard. The new standard is about 16% more efficient than the 1989 version. New equipment levels go into effect Oct. 29, 2001 and a user's manual is now available to assist in using the standard. There are currently 29 addenda out for public review. In addition, ASHRAE agreed to develop guideline 18 in informative language (not code compliant) to assist engineers in developing energy efficient buildings that go beyond Standard 90.1.

STANDARD 62.2 – Residential Ventilation Requirements for Acceptable Indoor Air Quality

ASHRAE is developing STD 62.2 and at the June 2000 meeting, the board approved sending the standard out for public review.

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STANDARD 161P – Air Quality Within Commercial Aircraft
ASHRAE is currently developing this standard.

STANDARD SPC 170 – Ventilation Standard for Health Care Facilities
ASHRAE has approved the development of this standard.

GUIDELINE 13P – Specifying Direct Digital Controls
ASHRAE approved the publication of this guideline.

Standards that are out for public review can be downloaded from the ASHRAE website (WWW.ASHRAE.ORG) along with a response form. Standards approved by the board of Directors can be ordered online from the ASHRAE bookstore.

ASHRAE LEARNING INSTITUTE (ALI)
ASHRAE is in the process of developing a "school" for professional HVAC courses. Currently, ASHRAE offers Professional Development Seminars (PDS) which can be used to maintain your Professional Engineering Status and self-guided learning courses. The plan is for ALI to provide a more complete offering.

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