FROM THE FIELD

Mechanical Design – Part 2

BY DAN FOLEY CONTRIBUTING WRITER

Last month's column delved into the process I use to create a mechanical design for a new house. I detailed how I generate load calculations, equipment selection, duct sizing, register and grille sizes, radiant design, and tubing layout. This month, I will show you how I aggregate this information into a complete mechanical design.

For most new houses, I will format my mechanical design to ANSI D paper size (22 inches x 34 inches) with the drawings at ¼ inch = 1foot scale. For larger homes, I will go to 3/16 inch scale or a larger paper size to get everything to fit. For some of our mega home projects, I may have to split up floor plans on multiple pages. I use Microsoft Visio for my mechanical drawings. It is inexpensive, easy to use and can create professional scaled drawings quickly and fairly easily, compared to other software programs available.

The first page, M-1, is always Mechanical Notes. It includes obvious data such as the date, my logo and address, job address, abbreviations index and mechanical symbol legend. I will also list additional information such as the mechanical code referenced in the design. This is important as new codes go into effect. For example, in Virginia, we are presently operating under 2009 IMC. As some of our projects may last several years, it is important to document the referenced code under which the job was designed.

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In addition, I will also list job notes, installation methods, piping, duct and equipment notes, joining methods, insulation notes, and any other job notes pertinent to the project. The final, but most important data I list on M-1 are the design assumptions. This section lists the assumptions around which the design was calculated. This includes design temperatures (indoor and ambient), construction details, insulation r-values, glazing u-values, infiltration parameters, and floor coverings. It is critical that you get accurate information from the architect, GC and owner, and have them sign off on it. Memories get hazy when problems occur down the road. For example, I had a client question why a certain room would not get down to 68°F during design conditions. I pulled out the design documents signed by all parties that indicated 72°F was the design condition for cooling when it was 98°F ambient.

On M-2, I will list equipment schedules. The schedules list the equipment as well as physical and electrical data. It includes unit designation, model number, BTU capacity, dimensions, weight, pipe connections, flue size, electrical characteristics, and other pertinent equipment data that varies by equipment. The architect may use this information to confirm that equipment will fit in designated spaces. The electrician and plumber will use this to size electrical circuits and gas lines. On commercial projects, the structural engineer may use this data to confirm the structure will handle the equipment weight. On larger projects, I may have several pages of schedules.

The next several pages, M-3 through M-6 on a three level home, will show the plan view of the scaled equipment and duct layout. It will detail the duct sizes and locations, equipment locations and designations, register and grille size and locations, cfm airflow, ventilation and exhaust ductwork, make-up air (if required), and thermostat locations. I will also include any notes that will help clarify my design for the installer, architect, GC or Authority Having Jurisdiction (AHJ). Examples of this may be mounting details, vent and termination locations, zone details, revision balloons, or references to other pages in the mechanical design documents.

If my design includes radiant floor heating, I will also include my loop layouts in this section but on separate pages. If I used Loop-Cad, I will import these drawings into my Visio drawing. If I used AutoCAD for the loop drawings, I can also import the DWG drawing into Visio. On some of my projects, I will draw the loops in Visio directly.

The next page will detail the hydronic flow diagram.

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On systems that have programmable controls, I will list the initial parameter settings. These settings may be adjusted during the commissioning process but I like to list the initial design settings as a starting point. This makes it easy to re-program a control if it fails and needs to be replaced.

This drawing shows how the equipment is piped and connected. It is not a scaled piping layout but rather a schematic that shows how the equipment interacts hydraulically. It shows equipment, designation, pipe size, flow rate, pressure drop, temperature drop, valve size and location, BTU capacity and hydronic component size and location. I use this for both hot water and chilled water. This flow diagram is generated with either Taco HSS, which is then imported into Visio, or Visio directly. Examples of each are posted on the *Phc News* website at http://bit.ly/11r4T1T.

It is important to recognize that this drawing is not a scaled piping layout. It is up to the practitioner to use this drawing to design the piping layout in the mechanical room. On some of our larger projects that have a tight mechanical room, I will use the flow diagram as I draw the mechanical room, typically at one-half scale, showing exact equipment and component location and connecting piping. I will draw this in plan view as well as interior elevations. This avoids turf wars in the mechanical room over location of mechanical systems. There are programs that automate this layout but I have found it easier to draw this in Visio. I have assembled quite a library of mechanical components that make this drawing easier to compose.

The next page is my controls schematic. I will draw a controls schematic and wiring diagram, and I will also list a sequence of operation on this page. This drawing is useful to the installer as the controls are installed and wired. It is critical when troubleshooting a system at some point down the road. It is difficult to diagnose a problem with the system if you do not know the intent of the controls designer.

On systems that have programmable controls, I will list the initial parameter settings. These settings may be adjusted during the commissioning process but I like to list the initial design settings as a starting point. This makes it easy to re-program a control if it fails and needs to be replaced. It also allows you to quickly determine if someone else has gotten into the controls and messed with the settings. A few minutes documenting the settings will save hours of headaches at some point in the future.

The last page in my design will show mechanical details. On this page, I will show equipment installation details, mounting details, radiant installation details, and manifold installation details. These drawings will show things such as mounting hardware, tubing installation and attachment methods, rough in dimensions, air filter

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location, condensate drain and trap piping, and duct and transition details.

It takes time to produce detailed mechanical design documents. This time must be accounted for in your job pricing. Yes, it may make your price higher than "Rusty Van" but don't look at this as a negative. It is what will help to make you a professional and will separate you from the pack. It adds value to your projects, gives your installers a roadmap to install your designs properly, and allows for easier troubleshooting and diagnostics when you come back for service. We leave a full set of drawings on the jobsite as well a copy in the office in the job folder. I also archive all my designs electronically.

I am happy to share any and all of my design documents with readers. None of these documents are my original ideas but rather bits and pieces that I have picked up over the years from fellow contractors and other design professionals.

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Examples of the documents referenced in this column are posted at the *Phc News* website here http://bit.ly/11r4T1T. Feel free to contact me by email me if you would like copies of my drawings in either AutoCAD or Visio formats.

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